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ABSTRACT

This study examined existing evaluations of drinking-age laws to determine the extent to which they provide empirical support for federal and state initiatives to change the legal drinking age. It specifically examined the effects that raising the minimum drinking age has had on traffic accidents, beverage alcohol consumption, driving after drinking, and related concerns for youths younger than the minimum age. A review of 49 documents which evaluated laws raising the legal drinking age revealed that raising the legal drinking age had a direct effect on reducing alcohol-related traffic accidents among youths affected by the laws. Evidence suggests that raising the drinking age results in a decline in both alcohol consumption and driving after drinking for the age group affected by the law. The evidence was insufficient to draw conclusions about the effects of raising the drinking age on youths 16 to 17 years old, border crossings, and other related matters. Literature reviews of earlier evaluations of the effects of lowering the drinking age, however, do give evidence that traffic-accident outcomes increased as a result of changes in the law. (Nine appendices, 16 tables, and 6 figures are included.) (NB)

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United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on Investigations and Oversight, Committee on Public Works and Transportation, House of Representatives

March 1987

DRINKING-AGE LAWS

An Evaluation Synthesis of Their Impact on Highway Safety

ED282150

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United States
General Accounting Office
Washington, D.C. 20548

Program Evaluation and
Methodology Division

B-222887

March 16, 1987

The Honorable James L. Oberstar
Chairman, Subcommittee on
Investigations and Oversight
Committee on Public Works and Transportation
House of Representatives

Dear Mr. Chairman:

In response to your October 21, 1985, letter, this report reviews existing evaluations of drinking-age laws to determine the extent to which they provide empirical support for federal and state initiatives to change the legal drinking age. As you know, controversy has been intense regarding the concept of a minimum drinking age, and critics on both sides of the debate have cited empirical support for their respective positions.

This study specifically examines the effect that raising the minimum drinking age has had on traffic accidents, beverage alcohol consumption, driving after drinking, and related concerns for youths younger than the minimum age. It also reports on the results of evaluations of lowering the legal drinking age.

As we arranged with your office, we are sending copies of this report to the secretary of the Department of Transportation and to the state and local highway safety and drug abuse officials who assisted us in identifying the available studies. We will also make copies available to others upon request.

Sincerely yours,

Eleanor Chelimsky
Director

Executive Summary

Purpose

Controversy has been intense regarding both the concept of a minimum drinking age that legally restricts alcoholic beverages to a specific age group and the effects of such a law on highway safety. Even though federal legislation (Public Law 98-363) promoting a "national minimum drinking age" of 21 was passed in July 1984, critics on both sides of the debate cite empirical support for their positions. Since enactment of the federal law, more than 20 studies have examined the effects of raising the drinking age.

The chairman of the Subcommittee on Investigations and Oversight of the House Committee on Public Works and Transportation asked GAO to examine the technical and methodological soundness of existing evaluations of drinking-age laws to determine the extent to which they provide empirical support for federal and state initiatives to change the legal drinking age. More specifically, the chairman asked GAO to report on the effect that raising the minimum drinking age has had on

- traffic accidents (that is, motor vehicle fatalities, personal injuries, and alcohol-related crashes);
- beverage alcohol consumption, along with driving after drinking; and
- other related subjects, such as crashes among youths younger than the legal drinking age, border crossings to states with lower drinking ages, the permanence of effects, and the effect of lowering the drinking age before the 1984 legislation.

Background

In response to increasing concern over the disproportionate involvement of young drivers in alcohol-related traffic accidents, the federal legislation enacted in July 1984 required that a portion of federal-aid highway funds be withheld from states that had not established 21 years as the minimum drinking age by law by September 30, 1986. The U.S. Department of Transportation (DOT) is reviewing state legislation to identify compliance with the federal drinking-age law. By October 1986, DOT had determined that eight states and Puerto Rico had drinking-age laws that did not meet the federal requirements.

To determine the extent to which there is empirical support for initiatives to raise the legal drinking age, GAO initially conducted a broad literature search for both published and unpublished evaluations on the subject. The search yielded more than 400 documents; 49 of them evaluated laws raising the legal drinking age. GAO then developed rating criteria, which were based on a preliminary review of the evaluations and

prior evaluation syntheses. A review panel applied the criteria to the 49 studies, focusing its analysis on the studies that met these criteria.

Results in Brief

Raising the drinking age has a direct effect on reducing alcohol-related traffic accidents among youths affected by the laws, on average, across the states. The evidence also supports the finding that states can generally expect reductions in their traffic accidents, but the magnitude of effects depends on the outcome measured and the characteristics of the state.

The available evidence suggests that raising the drinking age also results in a decline in alcohol consumption and in driving after drinking for the age group affected by the law. However, the limited quantity and quality of evaluations for these outcomes warrant caution in generalizing from results.

The evidence is insufficient to draw conclusions about the effects of raising the drinking age on youths 16 to 17 years old, border crossings, and other related matters. However, the literature reviews of earlier evaluations of the effects of lowering the drinking age do give evidence that traffic-accident outcomes increased as a result of changes in the law.

GAO's Analysis

Traffic Accidents

A reduction in alcohol-related traffic accidents for age groups affected by the law is, in fact, attributable to raising the drinking age. Almost all studies found statistically significant reductions in traffic-accident outcomes, even though the studies often varied in scope, design, analysis methods, and outcome measured. The 14 traffic accident studies that form the basis for this finding were high in quality, and their results were remarkably consistent with one another across different evaluation approaches. (See pages 26-40.)

Consumption and Driving After Drinking

The available evidence supports the claim that raising the purchase age reduces both the consumption of alcohol and the incidence of driving after drinking. However, generalizations are impeded by the small

number of studies of these outcomes (only 4 studies of alcohol consumption, 2 of which addressed driving-after-drinking practices), the geographical concentration of the states evaluated, and limitations in both available data (for example, alcohol sales figures are not disaggregated for specific age groups) and self-reported survey information. (See pages 42-48.)

Spillover Effects on Other Youths

The evidence is only limited for assessing the effects of changes in the law on the crash experience, alcohol consumption, and driving-after-drinking practices of youths younger than the minimum age, who are only indirectly affected by an increase in the legal drinking age. There was some evidence of no effect on crash experiences for this group; however, generalizations are impeded by the small number of studies that explicitly tested for this effect (2 of the 6 studies that met GAO's criteria) and the limited number of states studied. The 3 studies of consumption and driving-after-drinking practices for this age group presented mixed results. (See pages 50-56.)

Border-Crossing Effects

The evidence is insufficient to assess the extent of the border-crossing effect—that is, youths moving between states to legally obtain alcoholic beverages. Synthesizing the results of the 3 studies that met GAO's criteria was restricted by differing demographic characteristics between states, low crash involvement rates for drivers affected by the laws, and incremental age law changes. (See pages 58-60.)

Other Effects

The evidence is also insufficient to draw conclusions on the long-term effects of the law, although it suggests a sustained effect. Two studies addressing long-term effects met GAO's criteria. One was a national study that observed a sustained reduction in crashes among youths affected directly by the law. The other was a state study that found a modest reduction in long-term crash trends. GAO's assessment of the effects of lowering the drinking age, in contrast to raising the drinking age, was based on an analysis of the literature reviews of these studies, which concluded that an increase in traffic-accident outcomes could be attributed to a lowered drinking age. (See pages 60-63.)

Recommendations

This report contains no recommendations.

Agency Comments

The Department of Transportation reviewed a draft of this report and commended GAO for its excellent evaluation and synthesis of the available literature. The department's comments appear in appendix IX.

Contents

Executive Summary		2
Chapter 1 Introduction		10
	Trends in Drinking-Age Legislation	11
	Studies of the Drinking-Age Issue	13
	Objective, Scope, and Methodology	14
Chapter 2 Measures of Outcome		20
	Classification of Studies by Outcome Category	22
	Measures of Alcohol-Related Traffic Accidents	24
	Measures of Consumption and Driving After Drinking	25
Chapter 3 Effects on Traffic Accidents: Fatalities, Injuries, and Crashes		26
	Introduction	26
	The State of Evaluation Research on Traffic Accidents	27
	Results of Synthesis	32
Chapter 4 Effects on Consumption and Driving After Drinking		42
	The State of Evaluation Research on Consumption	42
	The State of Evaluation Research on Driving After Drinking	47
	Conclusions	47
Chapter 5 Effects on Youths Younger Than the Minimum Age		50
	The State of Evaluation Research on Traffic Accidents	50
	The State of Evaluation Research on Consumption and Driving After Drinking	53
	Conclusions	55
Chapter 6 Other Effects of Minimum Drinking-Age Laws		58
	The State of Evaluation Research on Border-Crossing Studies	58
	Long-Term Effects	60
	Effects of Lowering the Minimum Age	61
	Comparing the Effects of Lowering and Raising the Legal Drinking Age	64

Bibliography 102

Appendixes
Appendix I: Request Letter 66
Appendix II: State Minimum Drinking Ages 69
Appendix III: Potential Reductions in Federal-Aid Highway Funds for Noncomplying Jurisdictions 71
Appendix IV: A Chronology of the Minimum Drinking-Age Issue 72
Appendix V: The Relationship Between the Questions We Posed and the Evaluations We Synthesized 80
Appendix VI: Our Study Search Procedures and Methodology 82
Appendix VII: Our Data Collection Instruments 88
Appendix VIII: Our Summary Rating Sheet 95
Appendix IX: Comments From the Department of Transportation 97

Tables
Table 3.1: Number of Traffic-Accident Studies by Crash Outcome 27
Table 3.2: The Features of Four Studies on "Driver Fatal" Crashes Across States 28
Table 3.3: The Features of Five Studies on "Driver Fatal" Crashes in Selected States 29
Table 3.4: The Features of Four Studies on "Driver Fatal or Injury" Crashes 30
Table 3.5: The Features of Four Studies on "Driver" Crashes 31
Table 4.1: Number of Consumption and Driving-After-Drinking Studies by Outcome 42
Table 4.2: The Features of Four Studies on Alcohol Consumption 45
Table 5.1: Number of Studies on Youths Directly Below the Minimun Drinking Age 50
Table 5.2: The Features of Six Studies on Traffic Accidents Among Youths Directly Below the Minimum Age 51
Table 5.3: The Features of Three Studies on Alcohol Consumption and Driving After Drinking Among Youths Directly Below the Minimum Drinking Age 54
Table 6.1: Number of Studies on Three Other Topics 58

Table 6.2: The Features of Three Studies on Border Crossings 59
Table II.1: State Minimum Drinking Ages by Year of Enactment 69
Table V.1: The Coverage of Our Principal Topics by 49 Independent Studies 80
Table VI.1: Response Rates to Our Survey of Minimum Drinking-Age Law Evaluations 83
Table VI.2: Reasons for Unacceptable Study Ratings 85

Figures

Figure 1.1: Reconciliation of Our Synthesis Questions and the Evaluation Literature 16
Figure 2.1: Conceptual Model Linking a Minimum Drinking-Age Law With Highway Safety Outcomes 21
Figure 3.1: "Driver Fatal" Crashes Across States 34
Figure 3.2: "Driver Fatal" Crashes in Five States 35
Figure 3.3: "Driver Fatal or Injury" Crashes in Four States 37
Figure 3.4: "Driver" Crashes in Three States 38

Abbreviations

DOT	U.S. Department of Transportation
GAO	U.S. General Accounting Office
NHTSA	National Highway Traffic Safety Administration
3FS	Three-factor surrogate
2FS	Two-factor surrogate

Introduction

Concern over the disproportionate involvement of young drivers in alcohol-related traffic accidents resulted in Public Law 98-363, federal legislation to promote a "national minimum drinking age" of 21. A July 17, 1984, amendment to the Surface Transportation Assistance Act of 1982, this law provides for withholding federal highway funds from states that continue to allow persons younger than 21 to purchase or publicly possess alcoholic beverages after September 30, 1986. Cross-over sanctions (requiring compliance with the rules of one federal program as a condition for receiving funds for another program) to encourage the states to act in matters that are a state right (such as the right to regulate the sale of alcoholic beverages) were used in 1974 to encourage the states to adopt a 55-mile-per-hour speed limit and again in the 1984 amendment.

Congressional interest in raising the minimum drinking age nationwide was prompted by evidence linking younger drinking ages with increased alcohol-related deaths of youths on the highways. More specifically, various groups lobbied the Congress to address the border-crossing problem—that is, the risk posed to young drivers crossing state lines to obtain alcohol not legally available to them in the states where they reside. During 1984 hearings, it was estimated that 56 percent of the borders in this country separated states that had different legal drinking ages. Therefore, the Congress encouraged the establishment of a uniform drinking age nationwide as a way of reducing the incidence of driving between states after drinking among those affected by the law (typically 18-, 19-, and 20-year-olds).

In response to increasing pressures to change their drinking-age laws, 23 states have raised their minimum purchase age since the passage of Public Law 98-363. (The letter requesting this report is in appendix I. Appendix II is a list of the dates on which the states enacted their current drinking-age laws.) However, in spite of the growing public support for an older minimum drinking age and the potential loss of federal funds, 8 states and Puerto Rico had not yet complied with the federal requirements by October 1986. The National Highway Traffic Safety Administration (NHTSA) and the Federal Highway Administration, which are responsible for determining state compliance with the federal drinking-age law, have estimated from fiscal year 1986 appropriations that these jurisdictions may stand to lose between $3.6 million and $16.3 million in federal highway funds in fiscal year 1987 and twice as much in 1988. (See appendix III for potential reductions in federal-aid highway funds for noncomplying jurisdictions and a brief definition of what those funds are.)

Controversy surrounds the idea of a minimum drinking age and the actual effects that a change in the law may have had on traffic accidents among the ages affected by the law. For example, proponents of an older minimum age cite empirical studies that claim that lowering the drinking age significantly increased traffic accidents and that raising the drinking age reduced them among those affected by the law. Those who oppose raising the minimum drinking age take issue with not only the efficacy of the law but also its fairness.

Debate over a uniform drinking age of 21 has covered more than the sufficiency of evidence supporting the efficacy of this legislative action. Opponents of the legislation have also argued that it will (1) have negative consequences, such as reducing alcohol sales-tax revenue; (2) unfairly penalize most youths for the excesses of a few; (3) jeopardize the right of the states to control the availability of alcohol; and (4) not work as effectively as other deterrents, such as stricter enforcement of existing laws. Each of these additional concerns, in turn, has been countered by those who favor raising the drinking age.

We were asked by the chairman of the Subcommittee on Investigations and Oversight of the House Committee on Public Works and Transportation to review the empirical research regarding the effect that changes in the legal drinking age have had on traffic accidents (fatalities, injuries, and crashes), beverage alcohol consumption and other related matters among the youths affected by the laws. Since the enactment of Public Law 98-363 just 2 years ago, 24 studies have evaluated the effects of raising the minimum drinking age across and within states. Some of the recent studies have observed conflicting results and, therefore, we were asked to determine the extent to which these and previous evaluations provide empirical support for federal and state policy initiatives.

Trends in Drinking-Age Legislation

Legislative initiatives to control drinking behavior have historical roots in the governmental need to (1) control alcohol availability, (2) respond to the problem of drunk driving, and (3) protect young people. Trends in governmental activities can be seen in each of these needs, but the trends are interrelated and involve issues important to both public health and highway safety, although researchers in the two fields often approach them with different emphases.

Control of Alcohol Availability

Attitudes toward the control of alcohol availability were visible in colonial America, where drinking, even to excess, was socially acceptable and a normal part of life. Habitual drunkenness, however, was viewed as sinful and evidence of moral degradation. The more liberal colonial views gave way to the prohibition movement in the mid-1800's, which culminated in the ratification of the 18th amendment, prohibiting the sale of alcoholic beverages. Restrictive attitudes toward alcohol diminished with the repeal of the 18th amendment under social and political circumstances unrelated to the effectiveness of prohibition. Beginning in the 1930's, problem drinking in the form of alcoholism began to be regarded as a disease or a health problem for the individual. As this gradually became the accepted view, the major negative consequences of habitual alcohol abuse have been attributed more to the individual's particular physiological and psychological make-up than to the properties of alcohol or its availability.

Response to Drunk Driving

In the early 1970's, in a societal response to drunk driving, NHTSA funded a number of alcohol safety action projects, in an attempt to reduce alcohol-related crashes. These programs focused both on stepped-up enforcement of drunk-driving laws and on the more rapid and efficient processing of drinking-driver cases. In the mid-to-late 1970's, funding priorities shifted away from these programs, in partial response to the difficulties of assessing their effectiveness and of inducing prosecutors and judges to place any priority on the offense of drunk driving. In the late 1970's, however, attention was again drawn to the drunk-driving problem, primarily because of the activities of citizens' groups such as Mothers Against Drunk Driving, which began a long combat against the societal tolerance of driving after drinking. A presidential commission on drunk driving was formed in 1982, and numerous initiatives were introduced in the Congress to combat the drunk-driving problem.

Concomitant with the highway safety response to drunk driving was the development of a public health approach to this issue. The public health model of disease development was first applied to the epidemiology of alcohol-related problems in the 1970's. The model begins with an assessment of the availability of alcohol to the public in general and specifically to defined high-risk groups, such as young drivers. The model then follows the development of alcohol problems through consumption levels to the effects of alcohol on various alcohol-related problems, including drunk driving.

Protection of Youths

The Viet Nam War brought about a shift in the trend toward increased protection of youths by promoting adulthood at an earlier age and, subsequently, an important milestone in the protection of youths was the ratification of the 26th amendment in 1971, which extended the voting right to 18-year-olds. All the states followed the federal example by lowering their voting ages and, in many cases, they also reduced their minimum drinking ages below 21. However, in the mid-1970's, considerable controversy arose concerning the wisdom of lowering the drinking age.

Almost immediately after the laws were changed in some states, researchers began to recognize dramatic increases in the rate of alcohol-related crashes involving 18-, 19-, and 20-year-olds. National fatality data revealed that young drivers were overrepresented as a percentage of all fatal alcohol-related crashes and that the leading cause of death for youths 15 to 24 years of age was motor-vehicle crashes. Because of these data, state legislatures reversed the trend toward lowering their minimum drinking ages. No state has lowered its drinking age since 1975. (See appendix IV for a chronology of the minimum drinking-age issue.)

Studies of the Drinking-Age Issue

Critics of studies that evaluated the effects of lowering the drinking age on drivers of the ages affected by the law contended that the increasing accident trend for young drivers could be explained by (1) the long-term trends in crash data, (2) the increasing number of young drivers, and (3) the changes in police reporting practices. Limitations in the measures used to analyze accident outcomes were also a concern, particularly the presumed bias in police reports of alcohol-related crashes and the avoidance of this problem by using surrogate measures of alcohol involvement (such as "single-vehicle nighttime male drivers"). Other criticism pointed to the limited use and quality of "exposure data"—that is, the number of drivers registered, number of miles driven, and other risk factors.

Since the mid-1970's, when many states began to raise their minimum drinking ages, the introduction of comprehensive computerized data bases, maintained at both federal and state levels, improved the quality of the data used for studying highway safety. In addition, statistical techniques that were once the exclusive province of theoretical mathematicians have become accessible to highway safety researchers, as has computer software for those techniques. Some of the criticism of earlier studies is still voiced against the more recent studies of raising the

drinking age; however, the data bases have improved and so have the research designs.

Objective, Scope, and Methodology

Our objective in this study was to apply the evaluation synthesis methodology to the existing body of literature on the relation between minimum drinking-age laws and highway safety. Our purpose was to examine these evaluations critically, in order to determine their technical and methodological soundness and the credibility of claims that have been based upon them.

The following questions for the synthesis were derived from those proposed by the chairman of the subcommittee as being of interest, to the extent we could find a related body of research:

- Does raising or lowering the minimum drinking age result in a change in alcohol-related motor vehicle fatalities, injuries, and crashes among the age group affected by the law?
- Does raising or lowering the legal drinking age result in a change in beverage alcohol consumption among the age group affected by the law?

Other areas of interest to the subcommittee, provided they were sufficiently addressed in the literature, were the following:

- What are the displacement effects of changes in minimum drinking-age laws on alcohol-related crashes for young drivers not in the age group affected by the law (for example, the effects of a minimum age of 18 years on the crash experience of 16- and 17-year-old drivers)?
- What are the effects of differing minimum drinking-age laws on those who are affected by the law but reside in proximate jurisdictions (so-called "blood borders")?
- What are the long-term effects of changes in minimum drinking-age laws on the age groups affected by the law?
- How do the effects of lowered drinking-age laws compare with the effects of raised drinking-age laws?
- What is the magnitude of the effect of changes in minimum drinking-age laws on the age groups affected by the law?

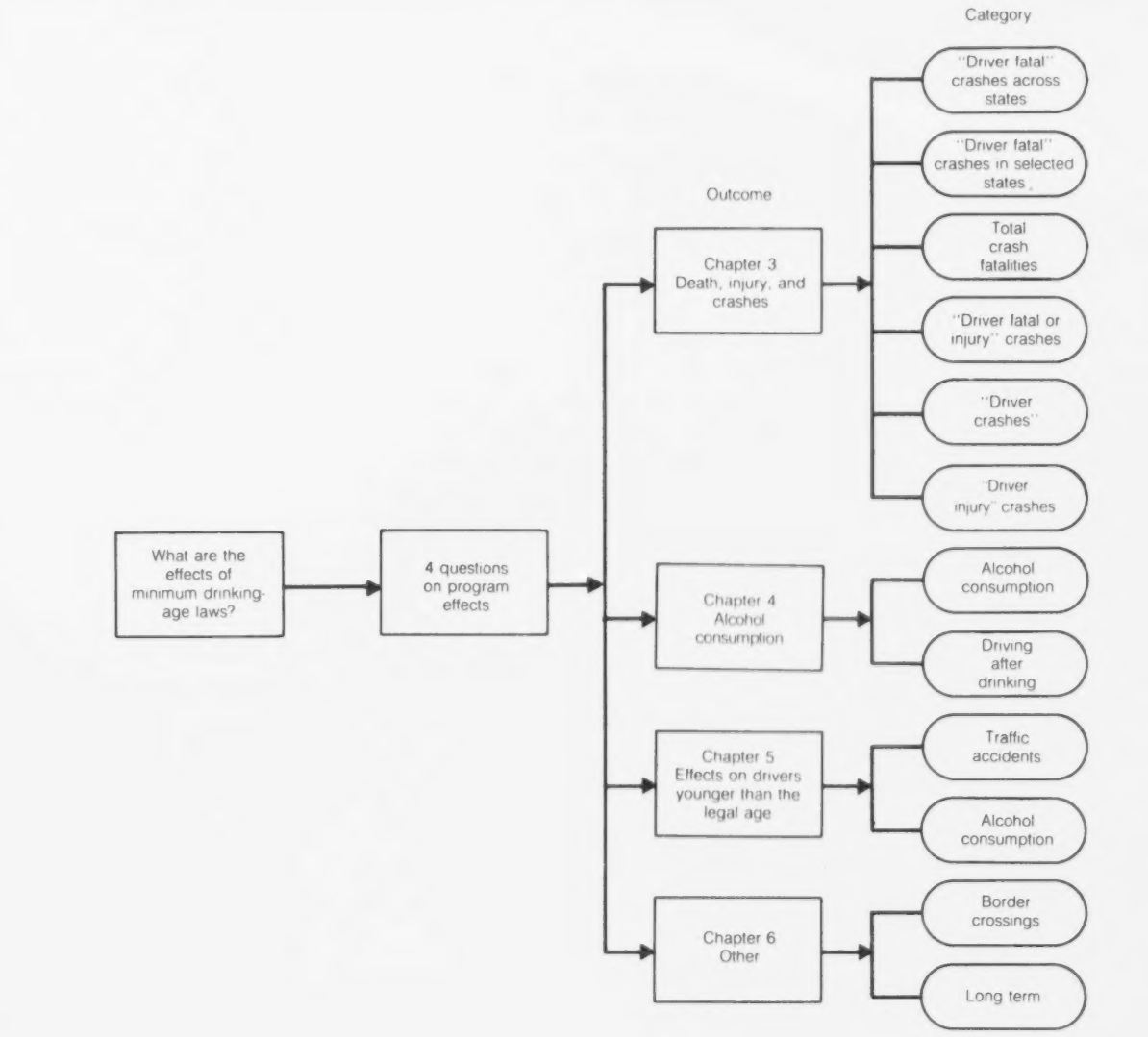
The synthesis resulted in the identification of a body of literature totaling more than 400 documents related to the issues of interest. We determined that these documents included 82 evaluations of the effects of changing the minimum drinking age. Thirty-three of the evaluations were directed at the issue of lowering the drinking age, no longer policy-

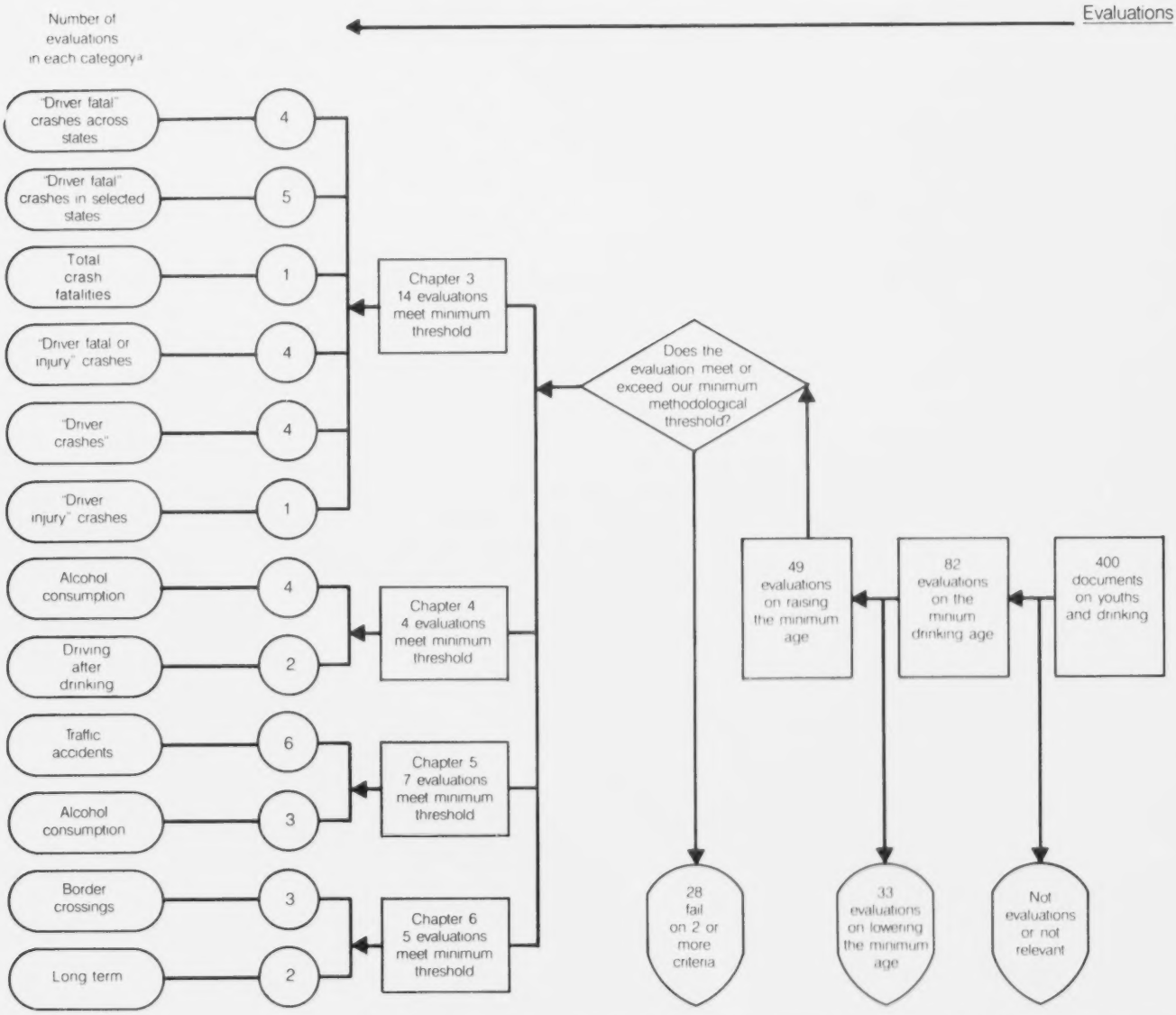
related, and are summarized in chapter 6. The remaining 49 evaluations of raising the drinking age were reviewed first separately and then jointly by a minimum of three researchers, to ensure that they met our minimum threshold criteria for appropriate research prior to synthesizing the results. (The bibliography at the end of this report lists the studies evaluating lowering the drinking age separately from those evaluating raising it.)

The second phase of work and the methodology checklist requested in the chairman's letter were eliminated after discussion with the office of the subcommittee.

Figure 1.1 reconciles the synthesis questions with the evaluation literature. The questions we were asked to address and the chapters in which they appear in the report are indicated on the left side of the figure. Each chapter addresses two to six subquestions that relate to the relevant question evaluated in each study. Our process of screening the body of literature related to the subject appears on the right side of the figure. Some studies that met our minimum-threshold criteria addressed more than one question and, therefore, some studies are discussed in several chapters. (See appendix V for a matrix showing the relationship between the questions we posed and the evaluations we synthesized.)

Figure 1.1: Reconciliation of Our Synthesis Questions and the Evaluation Literature





[a]These numbers do not always equal the total number of studies within or between chapters, since some evaluations considered more than one question.

Since the results of our analysis rely on the quality of data and analytical work in the evaluations we reviewed, we examine the methodological bases for this work in chapter 2. To aid the reader in examining our conclusions, we present a detailed discussion of our study search procedures and methodology (including our minimum-threshold criteria) in appendix VI. (Our data collection instruments and summary rating sheet are in appendixes VII and VIII.) A general review of the evaluation synthesis methodology is presented in GAO's The Evaluation Synthesis (Institute for Program Evaluation, Methods Paper 1, April 1983).

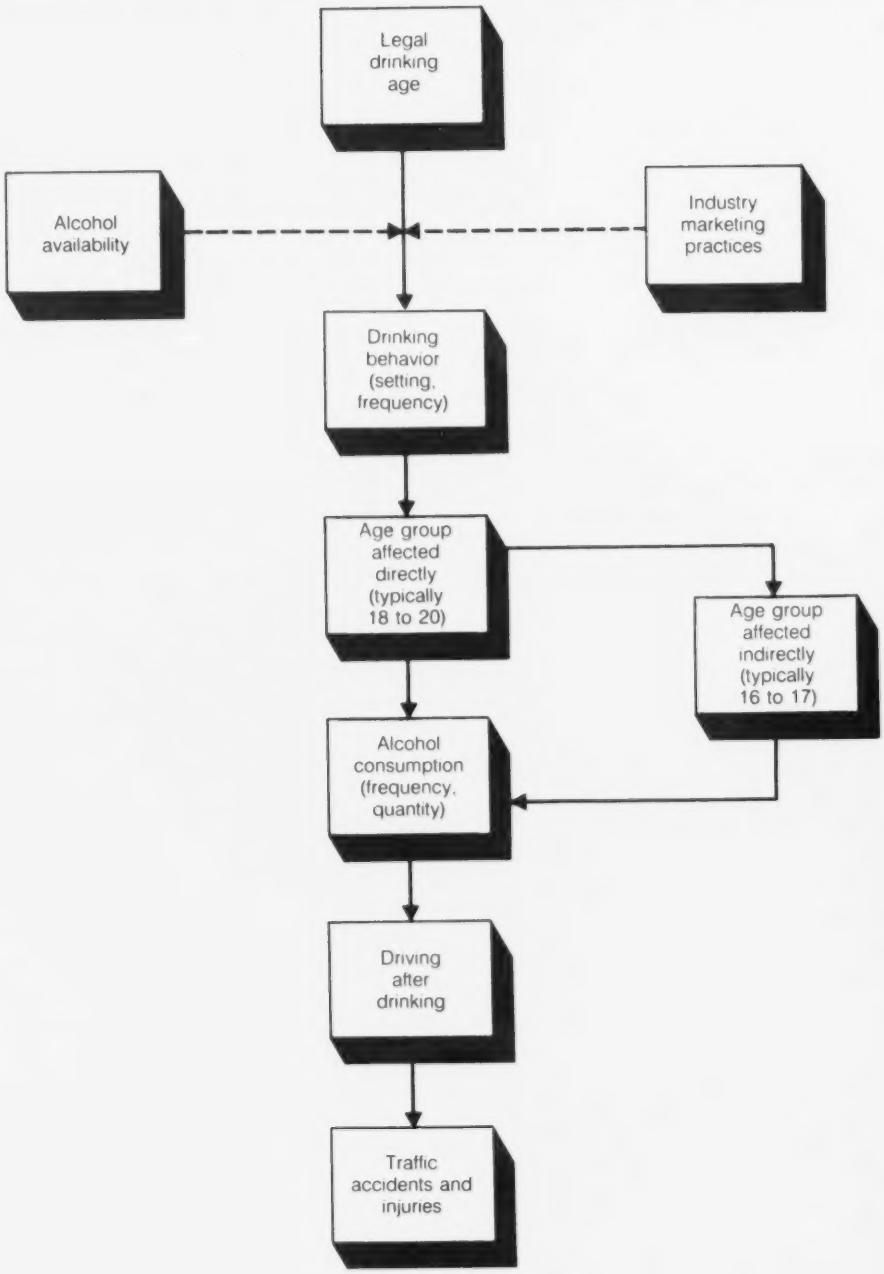
We solicited comments from the Department of Transportation on a draft of this report. In DOT's response, it commended GAO for its excellent report and indicated no objection to the report's publication. Where appropriate, we incorporated minor changes suggested by DOT. The full text of DOT's comments appears in appendix IX.

Chapter 2

Measures of Outcome

To assist the reader in understanding the body of literature being synthesized in chapters 3 through 6, we discuss the potential effects of a change in the drinking age and different measures used to assess the change. It is generally acknowledged that drinking-age laws do not affect traffic accidents directly but are mediated by a variety of intervening variables. A simplified conceptual model of the potential intermediate and long-term effects of the legislative change is presented in figure 2.1.

Figure 2.1: Conceptual Model Linking a Minimum Drinking-Age Law With Highway Safety Outcomes


Legal drinking age
Alcohol availability
Industry marketing practices
Drinking behavior (setting, frequency)
Age group affected directly (typically 18 to 20)
Age group affected indirectly (typically 16 to 17)
Alcohol consumption (frequency, quantity)
Driving after drinking
Traffic accidents and injuries

The model depicts how changes in the legal drinking age interact with other factors, such as marketing practices and changes in the availability of alcohol, to influence drinking-and-driving behavior. The evaluations we reviewed focused on traffic accidents as an indicator of this behavior and, to a lesser extent, on patterns in alcohol consumption. Few of the authors whose work we reviewed discussed any theoretical premise upon which to base their studies of the drinking age. Using a variety of measures, most tested directly for a relationship between the legal drinking age and crash experience or alcohol consumption.

Various empirical measures were used to evaluate the effect of changing the minimum drinking age on the highway safety outcomes in figure 2.1: observations of shifts in the number of traffic accidents, patterns of alcohol consumption, and the driving-after-drinking practices of the group granted or denied the right to purchase alcohol by the law over a period of time that included the law change.

Classification of Studies by Outcome Category

We classified each study we reviewed according to one of several outcome categories addressed by the evaluation. Studies that addressed more than one outcome, such as crashes involving both injury and fatalities, will be discussed more than once in the chapter on traffic accidents and may also appear in one of the other chapters.

The majority of the studies we reviewed examined traffic accidents, evaluating the effects of the law change in a variety of ways. Researchers measured the influence of alcohol on the crash experience of drivers in the age groups affected both directly and indirectly by the law for four categories of outcome:

- "Driver fatal crashes," or the outcome of a change in the law on the number of drivers in the age group who were directly affected by the law and involved in a motor vehicle crash in which one or more persons died from causes directly related to the crash, although the driver need not have been one of the victims. Crashes of this type are important to evaluate, but they are considered rare events. Thus, identifying a significant effect attributable to a law change can be confounded by large random variations in the number of fatalities from month to month or year to year, particularly in states with small populations.
- "Driver fatal or injury crashes," or the outcome of a change in the law on the number of drivers in the age group directly affected by the law and involved in a motor vehicle crash in which one or more persons died or were injured from causes directly related to the crash, although the

driver need not have been one of the casualties. Including in this category crashes in which there were no fatalities is important, because other factors such as the use of seat belts and the size of a car can affect whether an alcohol-related crash results in a death.

- "Driver crashes," or the outcome of a change in the law on drivers in the age group directly affected by the law who were involved in motor vehicle crashes that caused property damage. This outcome is the most inclusive, because it not only includes traffic accidents that caused injuries but may also include accidents that resulted only in property damages.
- "Driver injury crashes," or the outcome of a change in the law on drivers in the age group directly affected by the law who were involved in motor vehicle crashes that resulted in injuries to the driver or passengers. This category is a less-sensitive measure of outcome that can be attributed to the law change, because it includes more accidents that are unrelated to alcohol use than might be expected from drivers involved in crashes in which there is a fatality.

A fifth outcome category, reported in the studies reviewed, was total crash fatalities. Unlike the four other outcome categories, which considered as the unit of measure only whether the driver was in the directly affected age group, the crash fatality outcome considers as the unit of measure each crash victim among the age group affected by the law, regardless of a driver's age or level of intoxication. Studies measuring the fatality outcome are not concerned with the circumstances of a crash, whether it was alcohol-related, and in some cases the age of the drivers involved.

Two other outcomes we examined were

- the amount of consumption, or changes in the frequency and quantity of alcohol consumed associated with a change in the law, and
- the incidence of driving after drinking, or a change in driving-after-drinking practices associated with a change in the law.

According to the model in figure 2.1, the link between changes in the minimum drinking age and traffic accidents is separated by a variety of intervening variables, including the availability of alcohol and driving after drinking. Changes in the availability of alcohol to a given population are expected to have an effect on driving after drinking in that population, which, in turn, should affect the frequency of its involvement in alcohol-related crashes. Legal drinking-age restrictions will, therefore,

have some effect on the availability of alcohol but so will different aspects of public policy and the private market for alcoholic beverages.

The empirical evidence supporting an effect for separate intervening variables in the model is limited. The studies we reviewed attempted to evaluate shifts in the frequency and quantity of alcohol consumed by the relevant age group, before and after a change in the drinking age, primarily through survey techniques and aggregate alcohol sales figures. Self-reported surveys were also used to identify shifts in the pattern of driving after drinking that could be attributed to changes in the minimum drinking age.

Measures of Alcohol-Related Traffic Accidents

Most studies that evaluated the effects of changes in the minimum drinking age on the involvement of drivers in traffic accidents attempted to directly or indirectly focus on accidents in which a driver was under the influence of alcohol. The direct method relies on police reports on the impairment of the drivers involved in a crash. The indirect method relies on selective characteristics of a crash, such as time of day, to serve as a predictor or surrogate indicator of alcohol. A few studies did not attempt to measure the influence of alcohol on drivers but instead assumed that a deviation from normal crash trends among the age group affected by the law could reasonably be attributed to a change in the drinking age. All studies relied on crash data maintained through either the federal fatal-accident reporting system or state records.

Procedures for reporting the influence of alcohol on a driver's involvement in traffic accidents can take two possible routes: (1) through police observations that the driver had been drinking and (2) through coroners' reports, in cases in which the driver's blood-alcohol level was tested after death. Official police reports of accidents rely on either the impression of the investigating officer or the results of breath tests to determine the intoxication of the driver at the time of the crash. The presence of alcohol can also be determined by a coroner's or medical examiner's extraction, analysis, and reporting of alcohol content in the blood of one or more drivers who died in the crash.

Reporting alcohol involvement in crashes gives the most direct indication of driving after drinking; however, it has been criticized as biased in one form or another. Police observations of apparent intoxication on the part of one or more drivers is a subjective judgment influenced by the officer's perception of impairment, conditions under which the crash

took place, and pressure to report drunk drivers. For example, studies of alcohol-related crash reports suggest that compared to blood-alcohol tests, police judgment of the level of a driver's intoxication is correct approximately half the time.

Several surrogates for alcohol involvement in traffic accidents have been used to circumvent such bias. A common indirect measure uses a three-factor surrogate (3FS), which is based on the crash characteristics of time of day—that is, nighttime—sex of the driver—that is, male—and the number of vehicles involved in the crash—that is, a single vehicle. The 3FS has proven to be a fairly consistent predictor of alcohol-related crashes, because it has been determined that there is approximately a 53-percent to 63-percent probability that male drivers in the age group affected by the law who are involved in nighttime single-vehicle crashes are under the influence of alcohol. However, surrogate measures are reliable only to the extent that the ratio of alcohol-related surrogates to the total class of surrogates remains constant.

Measures of Consumption and Driving After Drinking

Survey techniques and the use of alcohol sales figures are the two primary approaches to determining the alcohol consumption rate for a specific population of interest. A specific age group can be surveyed through one of a variety of sampling and interviewing techniques to determine the frequency and quantity of alcohol consumed by this group. Self-reported surveys can also be used to identify shifts in patterns of driving after drinking. These survey techniques can provide useful information; however, there has been some controversy over whether a shift in reported consumption should be attributed to changes in the drinking age or to changes in social norms and drinking practices that would have occurred in the absence of a law change.

The other approach to determining alcohol consumption rate involves tracking alcohol sales figures over a period of time covering a change in the minimum drinking age. Data on alcohol sales can be obtained through either state taxation agencies or various alcoholic beverage associations. The major study limitation is that these data are not disaggregated across subgroups of the population below the state level. In other words, it is difficult, if not impossible, to evaluate changes in the consumption level of the age group affected by the law because these data are not available.

Effects on Traffic Accidents: Fatalities, Injuries, and Crashes

Introduction

In identifying and examining studies that evaluated the effects of raising the minimum drinking age on fatalities, injuries, and crashes among those in the age groups affected by the law across states and in selected states, we determined that 14 of 32 studies met our minimum threshold criteria. Studies suitable for synthesis were dispersed across five categories of outcome. For the "driver fatal" outcome, studies were conducted at both the national and state levels.

Variations Between Categories and Study Results

In each outcome category, the number of studies that met our minimum criteria varied, and so did the effects they observed. Categories varied in depth of support, from 9 studies of age group affected by the law in fatal crashes to 1 study evaluating "driver injury" crashes. The effects observed between studies differed, and so did the results within studies. For example, in one multiple state study, the effects of the law change ranged from a 75-percent reduction for one state to a 14-percent increase in another state, using the same outcome measure. Selected state studies of the effect that changing the legal drinking age had on drivers in the relevant age group were limited to Florida, Illinois, Iowa, Maine, Massachusetts, Michigan, and New York. However, crash data from most states that raised the legal drinking age were assessed in at least one multiple state study.

Differences Between Studies

Variations in study results within each traffic accident category stemmed from differences in study location, study design, analysis methods, and outcome measures. Variations in the geographical area studied can be associated with variations in demographics, road and weather conditions, law enforcement practices, and the quality of state data on crashes. These factors, in turn, can affect the outcome measure and confound the effects of drinking-age laws. Study designs ranged from a simple before-and-after intervention approach to lengthy time-series; analysis methods included a mixture of chi-square analysis, ratio comparisons, regression models, and Box-Jenkins time-series analysis. Finally, the influence of alcohol on drivers in the relevant age group, when considered, was measured directly (for example, with the "had been drinking" measure) or indirectly (for example, with the three-factor surrogate) for various categories of outcome, including those concerned with drivers involved in crashes that resulted in death, injury, or property damage.

The State of Evaluation Research on Traffic Accidents

We identified far more studies that met our minimum threshold criteria for the traffic-accident outcome than for other reported research areas. In addition, almost as many studies met our minimum criteria as did not. These latter studies were eliminated from our synthesis for several reasons, including contamination of study results by merging affected and unaffected age groups together in the analysis and failure to factor out the differences between groups attributable to the law change from the total differences between groups. Table 3.1 gives the number of studies identified for each outcome category.

Table 3.1: Number of Traffic-Accident Studies by Crash Outcome

Crash outcome category	Number of studies: Threshold met	Threshold not met	Total
"Driver fatal"			
Across states	4	5	**9**
Selected states	5	5	**10**
"Driver fatal or injury"	4	1	**5**
"Driver"	4	4	**8**
"Driver injury"	1	1	**2**
Total fatalities	1	4	**5**
Total	**19[a]**	**20[a]**	**39[a]**

[a]These figures differ from the total of 14 studies that met our threshold criteria and the 18 that did not, because some studies addressed more than one outcome.

"Driver Fatal" Crashes Across States

We identified 9 studies that evaluated the effect of raising the drinking age on "driver fatal" crash involvements across states. We found that 4 studies met our minimum threshold criteria: Arnold (1985), DuMouchel et al. (1985), Hoskin et al. (1986), and Williams et al. (1983). The studies ranged in scope from Williams' 9-state study to DuMouchel's study of 26 states. Each study evaluated the effect of changing the law on 18-, 19-, and 20-year-olds, in most cases using several years of crash data before and after the minimum drinking age was raised. Table 3.2 describes these studies.

Table 3.2: The Features of Four Studies on "Driver Fatal" Crashes Across States

Feature	Arnold (1985)[a]	DuMouchel et al. (1985)[b]	Hoskin et al. (1985)[c]	Williams et al. (1983)[d]
Study period	1975-82	1975-84	1977-80	January 1975 to September 1980
Location	13 states	26 states	10 states	9 states
Design characteristics	1-6 years before and 1-5 years after, comparing ratios	2-9 years before and 1-8 years after, using regression models	2-5 years before and 2-5 years after, comparing ratios	1-4 years before and 1-3 years after, comparing ratios
Outcome measure	"Driver fatal" crashes, averaged or pooled across states	Drivers involved in nighttime fatal crashes, averaged across states	Drivers involved in single-vehicle nighttime fatal crashes, averaged across states	Drivers involved in nighttime fatal crashes, averaged, pooled, or aggregated across states
Age group affected	18-20 years	18-20 years	18-20 years	18-20 years
Controls	Up to 23-years old; license rate	48 states; 12 regions; day crashes	25-29-years-olds; license rate	Up to 21 years old; 9 matched states; multiple crashes

[a]Robert D. Arnold, Effect of Raising the Legal Drinking Age on Driver Involvement in Fatal Crashes: The Experience of Thirteen States (Washington, D.C.: National Center for Statistics and Analysis, November 1985).

[b]William A. DuMouchel et al., Raising the Alcohol Purchase Age: Its Effect on Fatal Motor Crashes in 26 States (Washington, D.C.: Insurance Institute for Highway Safety, December 1985).

[c]Alan F. Hoskin et al., "The Effect of Raising the Legal Minimum Drinking Age on Fatal Crashes in Ten States," National Safety Council, Chicago, Ill., January 24, 1986.

[d]Allan F. Williams et al., "The Effect of Raising the Legal Minimum Drinking Age on Involvement in Fatal Crashes," The Journal of Legal Studies, 12 (1983), 169-79.

"Driver Fatal" Crashes in Selected States

Ten studies assessed the effects of raising the drinking age on "driver fatal" crashes for the relevant age groups in individual states. We found that 5 of the studies met our minimum threshold criteria: Emery (1983), Florida (1983), Hingson et al. (1983), Lillis et al. (1984), and Schroeder and Meyer (1983). The studies applied various designs and measures of outcome to evaluate crash data in Iowa, Florida, Massachusetts, New York, and Illinois, respectively. Table 3.3 describes these studies.

Table 3.3: The Features of Five Studies on "Driver Fatal" Crashes in Selected States

Feature	Emery (1983)[a]	Florida (1983)[b]	Hingson et al. (1983)[c]	Lillis et al. (1984)[d]	Schroeder and Meyer (1983)[e]
Study period	1975-81	October 1979 to September 1981	April 1976 to April 1981	December 1981 to December 1983	1977-82
Location	Iowa	Florida	Massachusetts	New York	Illinois
Design characteristics	3 years before and 3 years after	1 year before and 1 year after, using chi-square analysis	3 years before and 2 years after, using analysis of variance	1 year before and 1 year after	3 years before and 3 years after, using chi-square analysis and z tests
Outcome measure	"Driver fatal" crashes	"Driver fatal" crashes in which driver had been drinking	"Driver fatal" crashes in which driver had been drinking, averaged over 3 years	"Driver fatal" crashes and male drivers involved in single-vehicle nighttime fatal crashes, aggregated over 3 years	"Driver fatal" crashes and drivers involved in single-vehicle nighttime fatal crashes
Age group affected	18 years	18-19 years	18-19 years	18 years	19-20 years
Controls	19-20-year-olds; 21-year-olds and over	20-year-olds and over; 21-year-olds and over; license rate	18- and 19-year-olds in New York	19-20-year-olds; 20-year-olds and over; license rate	21-year-olds and over; license rate

[a]Joyce Emery, "Young Drinking Drivers Involved in Fatal Crashes," Statewide Problem Identification for F.Y. 1984 Highway Safety Plan (Des Moines, Iowa: Governor's Highway Safety Office, 1983).

[b]Florida Department of Community Affairs, Bureau of Highway Safety, Relation of the Legal Drinking Age to Young Drivers' Involvement in Traffic Accidents (Tallahassee, Fla.: March 1983).

[c]Ralph W. Hingson et al., "Impact of Legislation Raising the Legal Drinking Age in Massachusetts from 18 to 20," American Journal of Public Health, 73:2 (1983), 163-70.

[d]Robert P. Lillis et al., "Special Policy Consideration in Raising the Minimum Drinking Age: Border Crossing by Young Drivers," paper presented at the National Alcoholism Forum, Detroit, Mich., April 12-15, 1984.

[e]Joyce K. Schroeder and E. Dewayne Meyer, Influence of Raising the Legal Drinking Age in Illinois (Springfield, Ill.: Illinois Department of Transportation, Division of Traffic Safety, December 1983).

"Driver Fatal or Injury" Crashes

Five studies addressed the effect of raising the drinking age on "driver fatal or injury" crash involvements. Four studies met our minimum threshold criteria without any methodological limitations: Florida (1983), Lillis et al. (1984), Wagenaar et al. (1981), and Wagenaar (1984). The Wagenaar evaluations of Maine and Michigan crash data relied on multiple time-series models, whereas the studies of Florida and New York data used more straightforward before-and-after intervention analysis. The introduction of time-series analysis in this category helped rule out more alternative explanations for postulated causal relationships than other methods of analysis. Table 3.4 describes these four studies.

Table 3.4: The Features of Four Studies on "Driver Fatal or Injury" Crashes

Feature	Florida (1983)[a]	Lillis et al. (1984)[b]	Wagenaar et al. (1981)[c]	Wagenaar (1984)[d]
Study period	October 1979 to September 1981	December 1981 to December 1983	January 1972 to December 1979	January 1975 to December 1983
Location	Florida	New York	Maine and Michigan	Michigan
Design characteristics	1 year before and 1 year after, using chi-square analysis	1 year before and 1 year after	Time-series, using Box-Jenkins analysis	Time-series, using Box-Jenkins analysis
Outcome measure	"Driver fatal or injury" crashes in which driver had been drinking	"Driver fatal or injury" crashes in which driver had been drinking	"Driver fatal or injury" crashes in which driver had been drinking and male drivers involved in single-vehicle nighttime fatal or injury crashes	"Driver fatal or injury" crashes in which driver had been drinking and male drivers involved in single-vehicle nighttime fatal or injury crashes
Age group affected	18-19 years	18 years	18-19 years in Maine and Michigan	18-20 years
Controls	20-year-olds and over; license rate	19-20-year-olds; 20-year-olds and over; license rate	Older ages; New York and Pennsylvania; day crashes; nonalcohol crashes	21-year-olds and over; population

[a]Florida Department of Community Affairs, Bureau of Highway Safety, Relation of the Legal Drinking Age to Young Drivers' Involvement in Traffic Accidents (Tallahassee, Fla.: March 1983).

[b]Robert P. Lillis et al., "Special Policy Consideration in Raising the Minimum Drinking Age: Border Crossing by Young Drivers," paper presented at the National Alcoholism Forum, Detroit, Mich., April 12-15, 1984.

[c]Alexander C. Wagenaar et al., Raising the Legal Drinking Age in Michigan and Maine: Final Report (Ann Arbor, Mich.: University of Michigan Highway Safety Research Institute, 1981).

[d]Alexander C. Wagenaar, "Effects of Minimum Drinking Age on Alcohol-Related Traffic Crashes: The Michigan Experience Five Years Later," in H. Holder (eds.), Control Issues in Alcohol Abuse Prevention: Strategies for States and Communities (Greenwich, Conn.: JAI Press, forthcoming).

"Driver" Crashes

We identified eight studies that attempted to assess the effects of raising the drinking age on "driver" crash involvements. Data for Illinois, Maine, and Michigan were evaluated by four studies that met our minimum threshold criteria: Klein (1981), Maxwell (1981), Schroeder and Meyer (1983), and Wagenaar et al. (1981). (Klein and Wagenaar et al. studied Maine, and Maxwell and Schroeder and Meyer studied Illinois.) In most cases, a Box-Tiao or Box-Jenkins time-series analysis was used to evaluate surrogate indicators of alcohol-related crashes. Table 3.5 describes these studies.

Table 3.5: The Features of Four Studies on "Driver" Crashes

Feature	Klein (1981)[a]	Maxwell (1981)[b]	Schroeder and Meyer (1983)[c]	Wagenaar et al. (1981)[d]
Study period	1974-79	1977-80	1977-82	January 1972 to December 1979
Location	Maine	Illinois	Illinois	Maine and Michigan
Design characteristics	Time-series, using Box-Tiao analysis	Time-series, using Box-Tiao analysis	3 years before and 3 years after, using chi-square analysis	Time-series, using Box-Jenkins analysis
Outcome measure	Male drivers involved in nighttime crashes and single-vehicle nighttime crashes	Male drivers involved in single-vehicle nighttime crashes	Male drivers involved in single-vehicle nighttime crashes	Male drivers involved in single-vehicle nighttime crashes and driver had been drinking
Age group affected	18-19 years	19-20 years	19-20 years	18-19 years in Maine; 18-20 years in Michigan
Controls	20-year-olds; 21-year-olds and over; day crashes; license rate	21-22-year-olds and over	21-year-olds and over; license rate	Older ages in New York and Pennsylvania; day crashes; nonalcohol crashes

[a]Terry M. Klein, The Effect of Raising the Minimum Legal Drinking Age on Traffic Accidents in the State of Maine (Washington, D.C.: National Highway Traffic Safety Administration, 1981).

[b]Delmas M. Maxwell, Impact Analysis of the Raised Legal Drinking Age in Illinois (Washington, D.C.: National Highway Traffic Safety Administration, 1981).

[c]Joyce K. Schroeder and E. Dewayne Meyer, Influence of Raising the Legal Minimum Drinking Age in Illinois (Springfield, Ill.: Illinois Department of Transportation, Division of Traffic Safety, December 1983).

[d]Alexander C. Wagenaar et al., Raising the Legal Drinking Age in Michigan and Maine: Final Report (Ann Arbor, Mich.: University of Michigan, Highway Safety Research Institute, 1981).

"Driver Injury" Crashes

We were able to identify 2 studies that evaluated driver involvement in crashes that were restricted to injuries without death. The Florida Bureau of Highway Safety study (1983) met our minimum threshold criteria, but we eliminated the other study from our synthesis for several reasons. The study period in the Florida study was October 1979 to September 1981; all the data were from Florida for 1 year before and 1 year after, using chi-square analysis. The age group affected was 18-19 years old, and the controls were 20-year-olds and older others plus the license rate.

Total Crash Fatalities

We identified 5 studies that evaluated the effect of raising the drinking age on total crash fatalities for age groups affected by changes in the law. The Saffer and Grossman 1985 study was the only evaluation that met our minimum threshold criteria. The design of this study was sound; however, methodologically it differed from all other evaluations of

traffic-accident data in that the analysis focused on the age of the victim rather than the age of the driver. The Saffer and Grossman study period covered the 48 contiguous states. They based their research on a time-series of state cross-sections for 1975-81. The outcome measure was crash fatalities pooled across the 48 states for youths 18-20 years old. The controls were a group 21-24 years old and the license rate.

Results of Synthesis

We synthesized the results of 14 evaluations addressing five outcome categories and found that even though the evaluations differed in study location, design, analysis method, and outcome measure, the direction and often the magnitude of effects attributable to changes in the drinking age were generally similar. Statistically significant reductions (at a probability less than .05) in traffic accidents for the relevant age group were observed in almost every state evaluated. Caution should be used, however, in comparing study results between states and accident categories. In particular, study results are influenced by the selection of outcome measure and the geographical location of the study. Results also vary somewhat between studies that give percentage change as either a net reduction or an actual reduction. For example, if measures of crash data show declines for 18-year-old drivers affected by the law of 10 percent and increases of 2 percent in this outcome measure for 21-year-olds, who are not affected, the net reduction for the age group affected would be 12 percent.

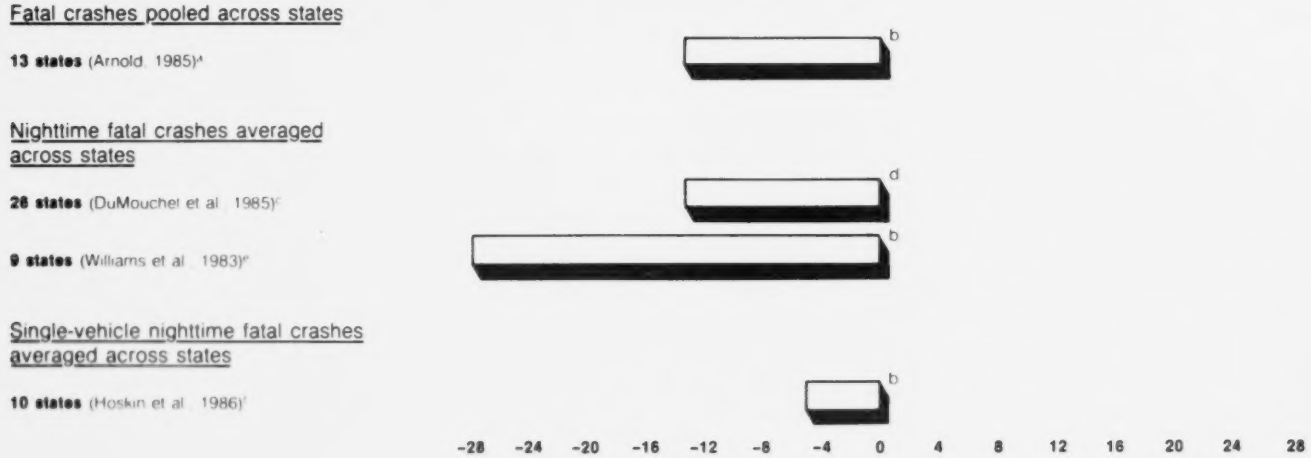
"Driver Fatal" Crashes Across States

Four multiple state studies of the effects of raising the drinking age on "driver fatal" crash involvements found crash reductions for age groups affected by the law during their study periods. The studies applied alternative design approaches to analyze various measures of "driver fatal" crashes and then averaged or pooled the effects across states. Their findings of reductions ranged from 5 percent (Hoskin et al., 1986) to 28 percent (Williams et al., 1983). Most individual states making up the pool of states evaluated in each study observed statistically significant reductions in this category; however, there were some exceptions. For example, in the Arnold (1985) study, Georgia, Iowa, and Maine exhibited a net percentage increase in "driver fatal" crashes for the age groups affected by the law during the study period.

We took a closer look at the multiple state studies in which the results of analyses of some states' crash data did not follow the typical downward trend in "driver fatal" crashes observed in other states and found several reasons for these exceptions. In Arnold's study of 13 states, 3 states

showed increases in "driver fatal" crashes but none of the results proved to be statistically significant. In the Hoskin et al. study of 10 states, Maine was found to have a statistically significant, 2-percent higher rate of "driver fatal" crashes. In less populous states such as Maine, however, analysis using small numbers (such as the number of drivers in the age group affected by the law in fatal crashes each year) can be distorted by one or two exceptional accidents during a study period, so that important treatment effects can be indistinguishable from chance outcomes. Analysis using even smaller numbers (such as drivers in the age group affected by the law involved in nighttime fatal crashes) for Montana may be the reason behind the statistically significant net percentage increase in fatal crashes observed in the Williams et al. study. Figure 3.1 summarizes these studies on "driver fatal" crashes.

Figure 3.1: "Driver Fatal" Crashes Across States


Fatal crashes pooled across states
13 states (Arnold, 1985)[a]
b
Nighttime fatal crashes averaged across states
28 states (DuMouchel et al., 1985)[c]
d
9 states (Williams et al., 1983)[e]
b
Single-vehicle nighttime fatal crashes averaged across states
10 states (Hoskin et al., 1986)[f]
b
-28 -24 -20 -16 -12 -8 -4 0 4 8 12 16 20 24 28
Percent change

[a]Robert D. Arnold, Effect of Raising the Legal Drinking Age on Driver Involvement in Fatal Crashes: The Experience of Thirteen States (Washington, D.C.: National Center for Statistics and Analysis, November 1985).

[b]Represents a net reduction in the outcome measure. Each percentage decrease is an estimated effect within a range of effects given at or above the 95-percent confidence level.

[c]William A. DuMouchel et al., Raising the Alcohol Purchase Age: Its Effect on Fatal Motor Vehicle Crashes in 26 States (Washington, D.C.: Insurance Institute for Highway Safety, December 1985).

[d]Each percentage decrease is an estimated effect within a range of effects given at or above the 95-percent confidence level.

[e]Allan F. Williams et al., "The Effect of Raising the Legal Minimum Drinking Age on Involvement in Fatal Crashes," The Journal of Legal Studies, 12 (1983), 169-79.

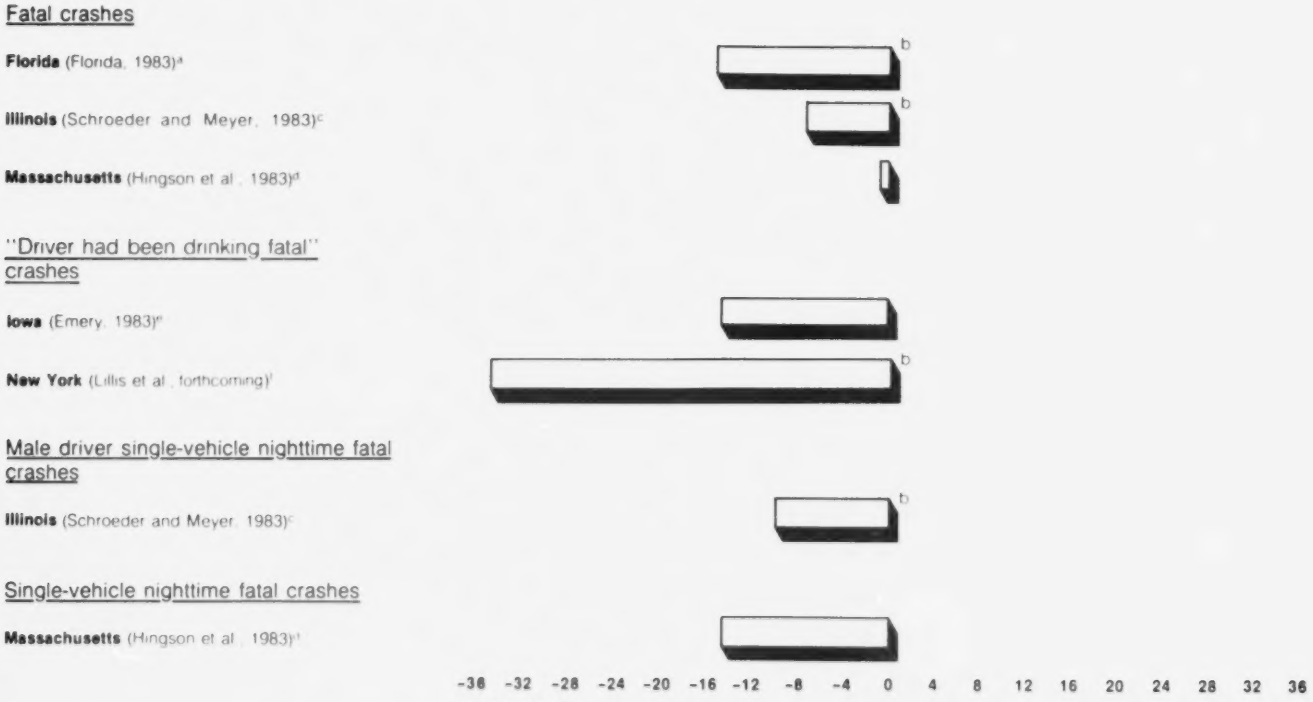
[f]Alan F. Hoskin et al., "The Effect of Raising the Legal Minimum Drinking Age on Fatal Crashes in Ten States," National Safety Council, Chicago, Ill., January 24, 1986.

"Driver Fatal" Crashes in Selected States

Evaluations of "driver fatal" crash involvements for the relevant age groups were conducted for Florida, Illinois, Iowa, Massachusetts, and New York. Applying various methods of analysis to different measures, 4 state studies found statistically significant reductions in the number of crashes attributable to older drinking ages. Effects observed in each state during separate study periods ranged from a 1-percent reduction in "driver fatal" crashes in Massachusetts to approximately a 35-percent reduction in "driver had been drinking fatal" crashes in New York. The 1983 Hingson et al. study of Massachusetts data and Emery's 1983

analysis of Iowa data were the only studies that did not show statistically significant effects for each outcome measure evaluated, although reductions were observed. Figure 3.2 summarizes the findings.

Figure 3.2: "Driver Fatal" Crashes in Five States


Fatal crashes
Florida (Florida, 1983)a
Illinois (Schroeder and Meyer, 1983)c
Massachusetts (Hingson et al., 1983)d
"Driver had been drinking fatal" crashes
Iowa (Emery, 1983)e
New York (Lillis et al., forthcoming)f
Male driver single-vehicle nighttime fatal crashes
Illinois (Schroeder and Meyer, 1983)c
Single-vehicle nighttime fatal crashes
Massachusetts (Hingson et al., 1983)d
b
-36 -32 -28 -24 -20 -16 -12 -8 -4 0 4 8 12 16 20 24 28 32 36
Percent change

[a]Florida Department of Community Affairs, Bureau of Highway Safety, Relation of the Legal Drinking Age to Young Drivers' Involvement in Traffic Accidents (Tallahassee, Fla., March 1983).

[b]Represents a net reduction in this outcome measure.

[c]Joyce K. Schroeder and E. Dewayne Meyer, Influence of Raising the Legal Minimum Drinking Age in Illinois (Springfield, Ill.: Illinois Department of Transportation, Division of Traffic Safety, December 1983).

[d]Ralph W. Hingson et al., "Impact of Legislation Raising the Legal Drinking Age in Massachusetts from 18 to 20," American Journal of Public Health, 73:2 (1983), 163-70.

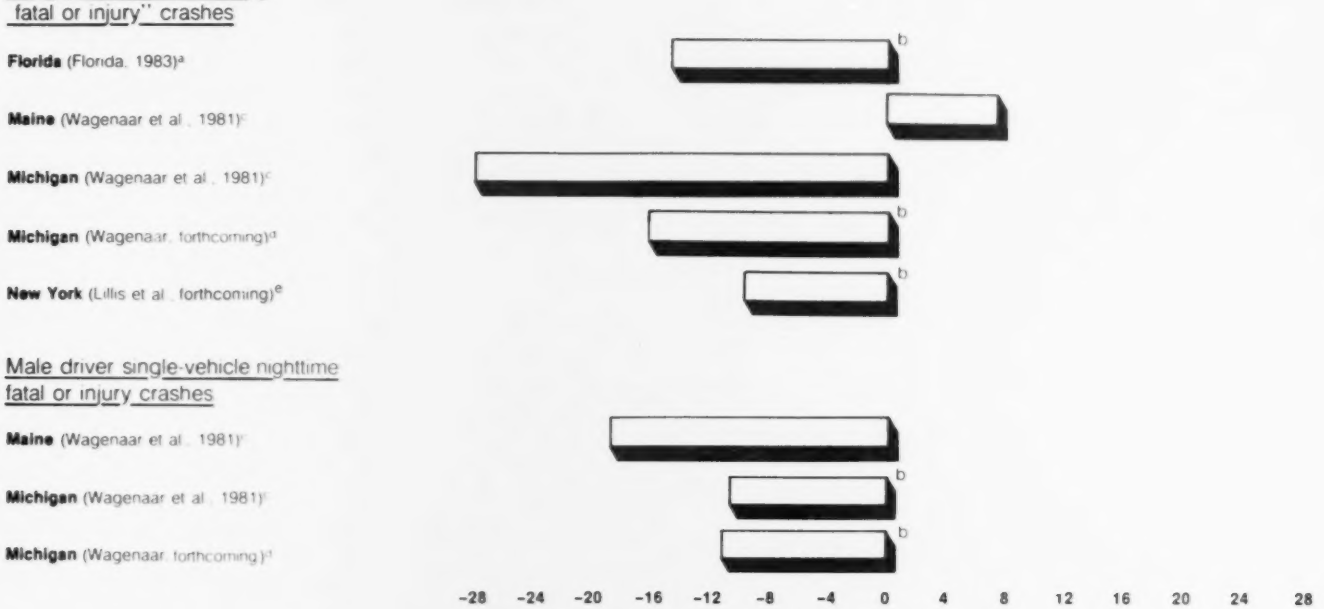
[e]Joyce Emery, "Young Drinking Drivers Involved in Fatal Crashes," Statewide Problem Identification for F.Y. 1984 Highway Safety Plan (Des Moines, Iowa: Governor's Highway Safety Office, 1983).

[f]Robert P. Lillis et al., "The Impact of the 19 Year Old Drinking Age in New York," in H. Holder (ed.), Control Issues in Alcohol Abuse Prevention: Strategies for States and Communities (Greenwich, Conn.: JAI Press, forthcoming).

"Driver Fatal or Injury" Crashes

Four studies of "driver fatal injury" crash involvements found reductions among those affected by the law in this category after the minimum drinking age was raised in each state. Analyses of data for Florida, Michigan, and New York showed statistically significant reductions ranging from about 10 percent in New York to 28 percent in Michigan. The measure of alcohol involvement in each study was based on either a reported incidence of drinking or a 1981 three-factor surrogate measure. For Maine, Wagenaar et al. (1981) found a statistically insignificant, slight increase in the had-been-drinking measure; however, reductions in magnitude and direction similar to those in other studies in this category were observed when the authors applied a three-factor surrogate measure to the Maine data. Figure 3.3 summarizes the findings.

Figure 3.3: "Driver Fatal or Injury" Crashes in Four States


"Driver had been drinking fatal or injury" crashes
Florida (Florida, 1983)[a]
Maine (Wagenaar et al., 1981)[c]
Michigan (Wagenaar et al., 1981)[c]
Michigan (Wagenaar, forthcoming)[d]
New York (Lillis et al., forthcoming)[e]
Male driver single-vehicle nighttime fatal or injury crashes
Maine (Wagenaar et al., 1981)[c]
Michigan (Wagenaar et al., 1981)[c]
Michigan (Wagenaar, forthcoming)[d]
b
-28 -24 -20 -16 -12 -8 -4 0 4 8 12 16 20 24 28
Percent change

[a]Florida Department of Community Affairs, Bureau of Highway Safety, Relation of the Legal Drinking Age to Young Drivers' Involvement in Traffic Accidents (Tallahassee, Fla., March 1983).

[b]Represents a net reduction in "driver fatal or injury" crashes.

[c]Alexander C. Wagenaar et al., Raising the Legal Drinking Age in Michigan and Maine: Final Report (Ann Arbor, Mich.: University of Michigan Highway Safety Research Institute, 1981).

[d]Alexander C. Wagenaar, "Effects of Minimum Drinking Age on Alcohol-Related Traffic Crashes: The Michigan Experience Five Years Later," in H. Holder (ed.), Control Issues in Alcohol Abuse Prevention: Strategies for States and Communities (Greenwich, Conn.: JAI Press, forthcoming).

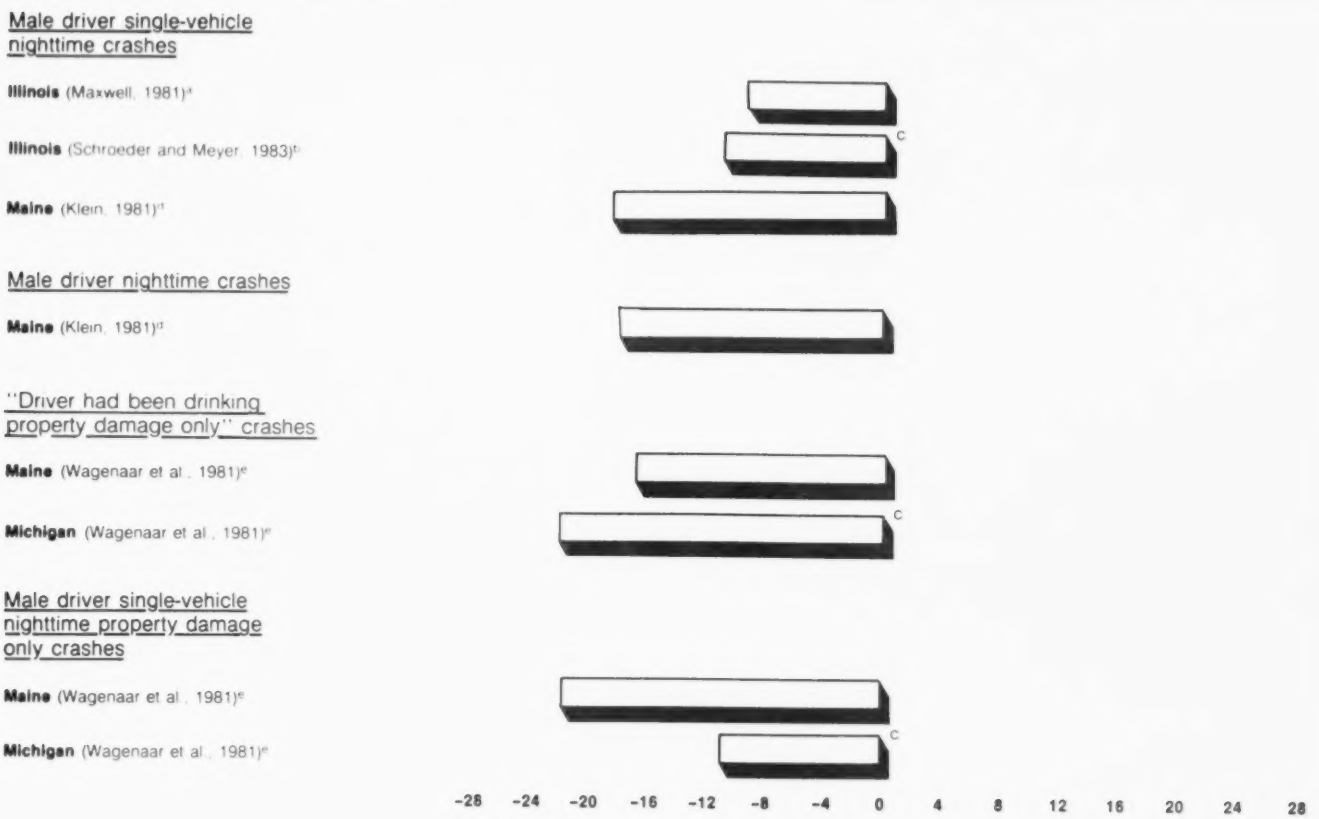
[e]Robert P. Lillis et al., "The Impact of the 19 Year Old Drinking Age in New York," in H. Holder (ed.), Control Issues in Alcohol Abuse Prevention: Strategies for States and Communities (Greenwich, Conn.: JAI Press, forthcoming).

"Driver" Crashes

Four studies of "driver" crash involvements for age groups affected by changes in the law found reductions in this category after the minimum drinking age was raised in each state. Analyses of Illinois, Maine, and Michigan crash data found statistically significant reductions ranging from a low of about 9 percent in Illinois to 22 percent in Michigan.

depending on the outcome measure used. Figure 3.4 summarizes the findings.

Figure 3.4: "Driver" Crashes in Three States


Male driver single-vehicle nighttime crashes
Illinois (Maxwell, 1981)[a]
Illinois (Schroeder and Meyer, 1983)[b]
Maine (Klein, 1981)[d]
Male driver nighttime crashes
Maine (Klein, 1981)[d]
"Driver had been drinking property damage only" crashes
Maine (Wagenaar et al., 1981)[e]
Michigan (Wagenaar et al., 1981)[e]
Male driver single-vehicle nighttime property damage only crashes
Maine (Wagenaar et al., 1981)[e]
Michigan (Wagenaar et al., 1981)[e]
c
-28 -24 -20 -16 -12 -8 -4 0 4 8 12 16 20 24 28
Percent change

[a]Delmas M. Maxwell, Impact Analysis of the Raised Legal Drinking Age in Illinois (Washington, D.C.: National Highway Traffic Safety Administration, 1981).

[b]Joyce K. Schroeder and E. Dewayne Meyer, Influence of Raising the Legal Minimum Drinking Age in Illinois (Springfield, Ill.: Illinois Department of Transportation, Division of Traffic Safety, December 1983).

[c]Represents a net reduction in "driver" crashes.

[d]Terry M. Klein, The Effect of Raising the Minimum Legal Drinking Age on Traffic Accidents in the State of Maine (Washington, D.C.: National Highway Traffic Safety Administration, 1981).

[e]Alexander C. Wagenaar et al., Raising the Legal Drinking Age in Michigan and Maine: Final Report (Ann Arbor, Mich.: University of Michigan, Highway Safety Research Institute, 1981).

An important consideration in synthesizing the results of these studies is that both Maine and Illinois were the focus of two independent evaluations. In Maine, Wagenaar et al. and Klein observed similar reductions (about 22 percent and 19 percent, respectively) in "driver" crashes but with somewhat different surrogate measures of alcohol involvement. The Wagenaar et al. study differed from Klein's evaluation in that it used only property damage crashes, a longer time-series, an additional measure of alcohol involvement, and drivers from a comparison state that had not changed its drinking age. The Schroeder and Meyer and Maxwell studies of Illinois data found similar results using the same surrogate measure of alcohol involvement (about 11 percent and 9 percent, respectively). Thus, the independent verification of the two states' experiences in raising the drinking age help corroborate the positive effects of the change in the law in these states.

"Driver Injury" Crashes

We found only one study that evaluated the effects of raising the drinking age on "driver injury" crash involvements for the age group affected by the law. This Florida study observed a statistically significant net reduction of approximately 2 percent in "driver injury" crashes during the study period.

Total Crash Fatalities

One nationally focused study of the effects of changes in the drinking age on total crash fatalities for age groups affected by the law found statistically significant effects across states. Saffer and Grossman (1985), analyzing national data during a period after many states raised their minimum drinking ages, found a 7-percent average reduction in fatalities in states with higher drinking ages.

Conclusions

In total, the evidence is persuasive that raising the minimum drinking age has had significant effects on reducing alcohol-related traffic accidents for the age group affected by the law. We conclude that states can generally expect reductions in their traffic accidents, but the magnitude will depend on the outcome measure evaluated and the characteristics of the state. This finding is supported through multiple observations of similar direction and, often, similar magnitude, obtained by alternative approaches to analyzing various measures of traffic accidents. Further support for our conclusion comes from the knowledge that such consistent findings rarely occur in reviews of this sort. Analyses of "driver" crash data also show that effects in the short-term are not restricted to reductions in injuries and fatalities alone but may, in our opinion, have

additional benefits in terms of costs associated with motor vehicle accidents not involving injury.

We found inconclusive evidence for some of the outcome categories (especially total crash fatalities and "driver injury" crashes) because of the superficiality of support available in these categories. Generalizations regarding average reductions to be expected on "driver fatal" crashes across states can be drawn from the multiple state studies; however, generalization regarding expected reductions in each outcome category cannot be made for states that were not studied.

Effects on Consumption and Driving After Drinking

Our reason for examining the effects of minimum drinking-age legislation on consumption and on driving after drinking is that the latter are major intervening links between a change in the law and a presumed effect on highway safety. (See figure 2.1 for the conceptual model linking drinking-age laws with highway safety outcomes.) Thus, any discernible change in consumption as measured by self-reporting or other reports of driving after drinking will serve as an indirect measure of the effect on highway safety.

We identified 12 studies that attempted to examine the relation between a raised minimum drinking age and levels or frequency of consumption by the age groups affected by the law. Four of these 12 studies, as shown in table 4.1, met or exceeded our minimum threshold criteria. Of the 8 studies not used in the synthesis, most were rejected for more than one reason. The most noteworthy deficiency was the inability of authors to disentangle the effect of laws setting a minimum age as they affect targeted versus untargeted age groups. This inability often results in a contaminated measure of who is affected, as when all 16-year-olds to 21-year-olds are grouped together. The result of this contamination is to minimize the real effect on the relevant age group or, worse, to lead to an inappropriate conclusion that the effect, if any, is too small to be statistically significant.

Table 4.1: Number of Consumption and Driving-After-Drinking Studies by Outcome

	Number of studies		
Outcome	Threshold met	Threshold not met	Total
Consumption	4	8	**12**
Driving after drinking	2	1	**3**

Three of the 12 studies on consumption also examined the relationship between a raised minimum drinking age and driving after drinking. Of these 3 studies, 2 met or exceeded the minimum threshold criteria.

The State of Evaluation Research on Consumption

Two of the 4 evaluations of consumption were based on the same before-and-after youth-alcohol study conducted in New York state. They used a three-stage, stratified, proportionate, random sampling design to select 2,000 youths 16 to 20 years old. They conducted the survey immediately prior to the raising of New York's minimum drinking age from 18 to 19. About 1 year later, a second survey was conducted.

Separate samples were drawn from New York City (as opposed to a primary sampling unit of the 57 upstate New York counties.) They sampled New York City separately, because prior research had shown that youths 16 to 20 years old there had an extremely low incidence of motor vehicle licensing, driving, and driving after drinking. Respondents in both samples were asked about their alcohol consumption patterns and alcohol-related driving experiences.

Lillis et al. (1986) presented their findings on beer purchasing and driving after drinking as one part of a multiple-indicator before-and-after comparison design. Other measures of the effect of an increased purchase age were police-reported "fatal" or "injury" crashes involving drinking drivers by age and changes in the age-specific arrest rate for driving while intoxicated by New York state police before and after the increase in legal purchase age from 18 to 19. Using three independent measures of the effects of the law change, it was possible to crossvalidate the findings and thereby increase confidence in the results.

Williams and Lillis (1985) also used the results of the two New York youth-alcohol surveys but concentrated on the 1,800 respondents chosen from the non-New York City counties and respondents who reported that they had taken a drink at least once in their lives. After disaggregating the data by age and sex, they reported the before-and-after effects for the following self-reported measures of frequency and quantity of drinking:

- drank in the last 28 days;
- drank on at least 1 of the last 8 weekend evenings;
- drank on at least 4 of the last 8 weekend evenings;
- drank at least 5 drinks per occasion on weekend evenings;
- drank on at least 4 of the last weekend evenings and drank at least 5 drinks per occasion.

Z-scores for the test of proportions between the two samples were given for each combination of age, sex, and frequency and quantity of drinking item.

Coate and Grossman (1985) employed cross-sectional dichotomous and multinomial logit estimation models to estimate the effect of a nationwide uniform minimum drinking age of 21. For a data base, they used the results of the second National Health and Nutrition Examination Survey that was conducted between February 1976 and February 1980. While the sample contained 21,000 persons between the ages of 6

months and 74 years, their study focused on the self-reported drinking occasions per week for 1,761 youths 16 to 21 years old in the 3 months before the interview. Each respondent was assigned a legal drinking age, which was based on the respondents' states of residence. Respondents resided in 63 of the 64 nationwide sampling units. Information on the number of drinks consumed in total or on a typical occasion was not obtained.

A problem that we note (and that Coate and Grossman also discuss) is the contamination of the dependent variable measure—number of drinking occasions per week in the past 3 months—by results from age groups not directly affected by the law. For example, raising a minimum-age law from 19 to 21 years should have some influence on the behavior of the 19- and 20-year-olds who are directly affected; in contrast, the law should have little or less effect on 16-, 17-, and 18-year-olds, who could not legally drink before or after the law change. Thus, grouping the results for youths 16-18 years old with the target age group, 19- and 20-year-olds, will have the effect of attenuating the results that would otherwise have been observed. In addition, Coate and Grossman further biased their findings downward by including 21-year-olds, a group unaffected by a law change, in the dependent variable. The net effect of contaminating the dependent measure is to attenuate the finding, but because it does not overstate the results, we have included it in the synthesis.

Perkins and Berkowitz (1985) surveyed first-year and second-year students at a New York undergraduate liberal arts institution both before New York raised the minimum age from 18 to 19 and more than a year later. The 797 respondents from before and 860 after represented response rates of 86 percent and 90 percent, respectively. The study asked questions about both frequency and quantity of drinking habits. The results were disaggregated by age of respondent and presented in tabular form. We have some reservations about this study as an indicator of the effectiveness of minimum drinking-age laws, because of the unique characteristics of the respondents and the component problem of generalizing from the findings to the population of all those affected by the law.

Table 4.2 presents the study characteristics for the four evaluations addressing the consumption question.

Table 4.2: The Features of Four Studies on Alcohol Consumption

Feature	Coate and Grossman (1985)[a]	Lillis et al. (1986)[b]	Perkins and Berkowitz (1985)[c]	Williams and Lillis (1985)[d]
Study period	1976-80	1982, 1983	1982, 1984	1982, 1983
Location	National probability sample	New York	New York	New York
Design characteristics	Cross-sectional multinomial logit models	Before and after	Before and after	Before and after
Outcome measure	Self-reported frequency of drinking, heavy, medium, light, or never	Self-reported purchase of beer in prior 28 days	Self-reported drinking habits and attitudes	Self-reported frequency and amount of consumption
Age group affected	Varies by state	18 years	18 years	18 years
Controls	Age groups vary by state	17-, 19, and 20-year-olds	19- and 20-year-olds and older	17-, 19-, and 20-year-olds

[a]Douglas Coate and Michael Grossman, "Effects of Alcoholic Beverage Prices and Legal Drinking Ages on Youth Alcohol Use: Result from the Second National Health and Nutrition Examination Survey," National Bureau of Economic Research, Cambridge, Mass., October 1985.

[b]Robert P. Lillis et al., "Special Policy Consideration in Raising the Minimum Drinking Age: Border Crossing by Young Drivers," paper presented at the National Alcoholism Forum, Detroit, Mich., April 12-15, 1984.

[c]Wesley H. Perkins and Alan D. Berkowitz, "Attitudes and Behavioral Responses to Changes in the Legal Drinking Age in a College Population," paper presented at the annual conference of the Alcohol and Drug Problem Association, Washington, D.C., August 18-21, 1985.

[d]Timothy P. Williams and Robert P. Lillis, "Changes in Alcohol Consumption by Eighteen Years Olds Following an Increase in New York State's Purchase Age to Nineteen," paper presented at the National Council on Alcoholism, National Alcoholism Forum, Washington, D.C., April 18-21, 1985.

Studies of the effect of raising minimum drinking-age laws are not as persuasive as the evaluations we synthesized in the prior chapter. The evidence, however, leads us to conclude that there is an inverse relationship between the minimum age and consumption. That is, the studies we reviewed showed a relationship between an increase in the minimum age and a decrease in the frequency and amount of drinking for the relevant age groups.

There are two reasons for our caution in reaching this conclusion. First, we found only 4 evaluations of the minimum drinking age and consumption that met our minimum threshold criteria. Second, we have some concern about the geographical concentration of the findings and the consequent implications for generalization. Three of the 4 studies are based on surveys conducted within the state of New York. Two of these 3 employed the same data base (random before-and-after samples of 2,000 age-specific respondents), while the other New York study was limited to a survey of first-year and second-year students at an undergraduate liberal arts school. Accordingly, we do not believe these results can be generalized to other specific states.

Lillis et al. (1986) used the New York survey of 2,000 respondents and found that the rate of self-reported purchasing of beer by 18-year-old licensed drivers decreased significantly (37 percent) after the legal age was increased from 18 to 19 years. Fifty-two percent of 18-year-olds reported purchasing beer before the law change; 33 percent reported doing so after. They also found that the rate of purchasing by 18-year-olds (33 percent) was significantly smaller than for 19- and 20-year-olds (51 percent and 47 percent) after the legal age was changed.

Williams and Lillis (1985) also used the New York survey and concluded that after the minimum purchase age was raised from 18 to 19 years, 18-year-olds showed significant decreases at all levels of drinking, including the heaviest level (drank on at least 4 of the last 8 weekend evenings and drank at least 5 drinks per occasion). The decreases for 18-year-old males were significantly greater than for 20-year-olds for all levels of consumption. Eighteen-year-old females showed significant decreases in all levels, except the heaviest drinking level, which nonetheless went down from 19 percent to 14 percent. Decreases for 18-year-old females were also greater than for older age groups not affected by the law. Finally, females did not tend to differ from males at the lowest drinking rate, but as drinking increased, females reported significantly less involvement compared to males.

The before-and-after survey of Perkins and Berkowitz (1985) of freshmen and sophomores in New York showed that consumption decreased along various measures by between 6 and 35 percent for the relevant age group (18 years old) after the minimum age increased from 18 to 19.

Coate and Grossman (1985) in a national cross-sectional analysis of drinking frequency concluded that the frequency distribution of consumption levels among youths would be expected to change as follows if every state had a minimum legal drinking age of 21 years:

- Drinking 4 to 7 times per week would decrease 15 percent.
- Drinking 1 to 3 times per week would decrease 6 percent.
- Drinking less than once per week would increase 1 percent.
- Not drinking would increase 6 percent.

The State of Evaluation Research on Driving After Drinking

The number of driving-after-drinking studies was even more sparse than the number on the consumption question. Two met our minimum threshold criteria, and both were discussed above—Lillis et al. (1986) and Perkins and Berkowitz (1985). The study characteristics for both were the same as shown in table 4.2, except for the outcome measures used. Lillis et al. used the incidence of self-reported driving after feeling the effects of alcohol in the prior 28-day period. The outcome measure employed by Perkins and Berkowitz was self-reported driving while impaired because of alcohol during the prior year.

Both studies showed that an increase in the minimum drinking age was followed by a decrease in the incidence of driving after drinking by those in the age group affected. Both evaluations ensured statistical confidence in their results, but we believe an earlier note of caution is worth repeating. That is, two studies alone do not represent a very broad base from which to generalize conclusions. Both focused on New York, which also limits the extent to which the results can be generalized to other specific states. Finally, both suffer from the weakness of relying solely on self-reported results.

Conclusions

The evaluation of the effectiveness of minimum drinking-age laws as they relate to consumption and the incidence of driving after drinking are impeded by a lack of consumption data that are age specific, the unverifiable nature of self-reported drinking behavior, and a frequently observed contamination of the consumption outcome measure by the inclusion of age groups both directly and indirectly affected by the law. Nonetheless, we believe some conclusions are warranted.

Although we found few acceptable studies of the effect of minimum drinking-age laws on consumption for the age groups affected, those that were acceptable did show that an increase in the minimum age had a statistically significant effect on the self-reported frequency and level of consumption for the targeted age group. We also found even fewer studies of the relationship between minimum drinking-age laws and the incidence of driving after drinking. Of the 2 studies we identified, both supported the conclusion that increasing the minimum age resulted in a decrease in self-reported driving after drinking.

In conclusion, we believe the evidence demonstrates the efficacy of minimum drinking-age laws as they relate to both changes in self-reported consumption and the incidence of driving after drinking. However, the geographical concentration of the evidence and the sparseness of the

research—especially as it relates to driving after drinking—mean that the results cannot be generalized to specific states or jurisdictions.

Effects on Youths Younger Than the Minimum Age

Arguments supporting an older legal drinking age are not restricted to the potential benefits for the age groups directly affected by the law. A complementary issue that is dealt with in the studies we reviewed is the potential effect of a change in the law on 16- and 17-year-olds. Because 18-year-olds are typically seniors in high school, it has been argued that legally entitling them to drink may make alcohol more accessible to their younger classmates.

In this chapter, we discuss potential effects on accident involvement among those younger than the minimum age and their patterns of consumption and driving after drinking. Table 5.1 displays the number of studies that addressed these outcomes and the number that met our minimum threshold criteria. Two of the 8 studies that examined accident involvement did not meet our minimum threshold criteria: inadequate controls for chance and other factors made inferences from them problematic.

Table 5.1: Number of Studies on Youths Directly Below the Minimum Drinking Age

Outcome	Number of studies: Threshold met	Threshold not met	Total
Traffic accidents	6	2	**8**
Consumption and driving after drinking	3	0	**3**

The State of Evaluation Research on Traffic Accidents

The 6 remaining studies are described in table 5.2. As the table shows, all the evaluations employed some form of before-and-after design, and most evaluated the law change in a single state. The potential effects of increasing the legal drinking age in six states were analyzed; Maine was the subject of two independent assessments.

Table 5.2: The Features of Six Studies on Traffic Accidents Among Youths Directly Below the Minimum Age

Feature	Florida (1983)[a]	Klein (1981)[b]	Lillis et al. (1986)[c]	Maxwell (1981)[d]	Smith et al. (1984)[e]	Wagenaar et al. (1981)[f]
Study period	October 1979 to September 1981	1974-79	December 1981, December 1983	1977-80	1976-82	1972-79
Location	Florida	Maine	New York	Illinois	Massachusetts	Maine and Michigan
Design characteristics	3 years before, 1 year after	Time-series, Box-Tiao intervention analysis	1 year before, 1 year after	Time-series, Box-Tiao intervention analysis	3 years before, 3 years after	Time-series, Box-Jenkins intervention analysis
Outcome measure	Number of drivers involved in fatal and injury accidents and number in fatal and injury accidents who had been drinking	Male drivers in single-vehicle nighttime accidents and male drivers in nighttime accidents	Fatal and injury alcohol-involved crashes	Male drivers in single-vehicle nighttime crashes	Fatal crashes; single-vehicle nighttime fatal crashes	Male drivers who had been drinking and male drivers in single-vehicle nighttime noninjury and injury and fatal crashes
Age group affected	17 years	16 and 17 years	17 years	16-18 years	16 and 17 years	16 and 17 years
Controls	20-year-olds and older; license rate	Persons 20 and 21 years old; annual license data; male drivers in single-vehicle daytime accidents	License rate	Persons 21 and 22 years old and older	New York; older and comparable age groups within and between states; nonfatal accidents	New York and Pennsylvania; older and comparable age groups within and between states; daytime and all accidents

[a]Florida Department of Community Affairs, Bureau of Highway Safety, Relation of the Legal Drinking Age to Young Drivers' Involvement in Traffic Accidents (Tallahassee, Fla.: March 1983).

[b]Terry M. Klein, The Effect of Raising the Minimum Legal Drinking Age on Traffic Accidents in the State of Maine (Washington, D.C.: National Highway Traffic Safety Administration, 1981).

[c]Robert P. Lillis et al., "The Impact of the 19 Year Old Drinking Age in New York," in H. Holder (ed.), Control Issues in Alcohol Abuse Prevention: Strategies for States and Communities (Greenwich, Conn.: JAI Press, 1986).

[d]Delmar M. Maxwell, Impact Analysis of the Raised Legal Drinking Age in Illinois (Washington, D.C.: National Highway Traffic Safety Administration, 1981).

[e]Robert A. Smith et al., "Legislation Raising the Legal Drinking Age in Massachusetts from 18 to 20: Effect on 16 and 17 Year Olds," Journal of Studies on Alcohol, 45:6 (November 1984), 534-39.

[f]Alexander C. Wagenaar et al., Raising the Legal Drinking Age in Michigan and Maine: Final Report (Ann Arbor, Mich.: University of Michigan, Highway Safety Research Institute, 1981).

For the studies we reviewed, measures of accident involvement varied considerably. Maxwell (1981) restricted her analysis to male drivers in single-vehicle nighttime accidents, while Wagenaar et al. (1981) used both a three-factor surrogate measure and a police-reported alcohol-involvement measure for injury and noninjury accidents. Five of the 6 evaluations employed multiple measures of accident involvement.

Although all the studies presented data on potential effects on youths directly below the legal drinking age, only Smith et al. (1984) and Wagenaar et al. explicitly tested for these effects. We place more confidence in their results because they extended their analyses beyond the older group (typically persons 18, 19, and 20 years old) and used both interstate and intrastate comparison groups.

The remaining studies provided limited analyses of potential effects and, in two cases, flawed comparison groups. The Florida study (1983) combined drivers with higher risks (20 to 25 years old) with drivers with lower risks (26 years old and older) to evaluate potential effects for 17-year-olds. Lillis et al. (1986) presented data for groups 18-20 years old but restricted their analysis to the difference between 17-year-old and 18-year-old drivers. Klein (1981) and Maxwell analyzed time-series data for more than five discrete age groups; however, the focus of their evaluations was on the older age group.

Results for Traffic Accidents

Our review of the results of the 6 studies suggests the absence of an effect on the traffic-accident involvement of youths younger than the minimum age, typically 16 and 17 years old. Wagenaar found that Michigan's greater drinking age did not affect the frequency of property damage accidents or injury and fatal accidents among 16- and 17-year-old drivers. Although decreases were observed in all measures of alcohol involvement for the younger drivers, nonalcohol related indicators also declined. Similar results were reported for 16- and 17-year-old Maine drivers. Wagenaar et al. suggests that the small number of crashes for young Maine drivers and the resultant large random component in the time-series may have masked any effect.

Klein's evaluation of Maine's increased legal drinking age yielded similar results. He reported no significant differences in single-vehicle nighttime male driver involvements or in nighttime male driver involvements for 16- and 17-year-old drivers. This contrasted with significant differences for 18-year-olds involved in single-vehicle accidents and for 18- and 19-year-old drivers involved in nighttime accidents; slight increases were observed in three of the four estimates for the younger drivers.

Maxwell evaluated the effect of increasing the drinking age from 19 to 21 in Illinois. Although estimates for 16-, 17-, and 18-year-olds declined by approximately 5 percent, they were not statistically significant. Because the minimum legal drinking age was 19, the likelihood of an effect on 16- and 17-year-olds may have been diminished.

Smith examined the effects of an increased legal drinking age on the crash involvement of 16- and 17-year-olds in Massachusetts. Although there was a significant reduction in nonfatal accidents in Massachusetts compared to New York, no decline in fatal crashes or in single-vehicle nighttime fatal crashes was found.

The studies in which we place less confidence reported contrasting results. The Florida study found statistically significant differences, comparing 17-year-old drivers to drivers 20 and older for alcohol-involved fatal and injury accidents. In New York, Lillis et al. found that before the law change, the incidence of fatal crashes and fatal or injury crashes was significantly greater for 18-year-olds than for 17-year-olds. Following the increase in the legal drinking age, the rates of fatal crashes no longer differed significantly for those age groups, although the rates of fatal and injury crashes still differed significantly. Because 17-year-olds were treated more as a control group than an experimental group, comparisons necessary to assess an effect on the younger drivers were not employed.

Summary of Results

We conclude that there is little evidence to suggest that an increase in the legal drinking age has an effect on the involvement of 16- and 17-year-old drivers in alcohol-related accidents. The studies on their crash experience that we considered the most credible consistently found no statistically significant differences in the outcome measures for 16- and 17-year-old drivers. Caution in interpreting these results, however, is warranted. First, the studies reporting these results were limited to four states. Second, results from evaluations of two other states, which we considered less credible, do suggest a possible effect. Third, most of the studies focused on the directly affected age group and offered limited analyses for younger drivers. The two evaluations that did explicitly test for an effect on younger drivers, however, found no evidence of one.

The State of Evaluation Research on Consumption and Driving After Drinking

We identified only 3 studies that considered the effects of raising the drinking age on the alcohol consumption patterns of youths directly below the minimum age. Two of these also analyzed changes in driving after drinking. These studies were restricted to two states, Massachusetts and New York, and relied almost exclusively on survey data collected before and after the enactment of an older legal drinking age. The studies we reviewed are described in table 5.3.

Table 5.3: The Features of Three Studies on Alcohol Consumption and Driving After Drinking Among Youths Directly Below the Minimum Drinking Age

Feature	Lillis et al. (1986)[a]	Smith et al. (1984)[b]	Williams et al. (1983)[c]
Study period[d]	December 1981 to December 1983	1979-81	November 1982 to December 1983
Location	New York	Massachusetts	New York
Design characteristics	1 year before, 1 year after	1 year before, 2 years after	1 month before, 1 year after
Outcome measure	Arrest for driving while intoxicated; telephone survey data of reported drinking and driving	Telephone survey of reported alcohol consumption and driving after drinking	Telephone survey of reported quantity and frequency of alcohol consumption
Age group affected	16 and 17 years	16 and 17 years	17 years
Controls	18-, 19-, and 20-year-olds and older; license rate	Equivalent and older age groups from comparison state	18-year-olds; license rate

[a]Robert P. Lillis et al., "The Impact of the 19 Year Old Drinking Age in New York," in H. Holder (ed.), Control Issues in Alcohol Abuse Prevention: Strategies for States and Communities (Greenwich, Conn.: JAI Press, 1986).

[b]Robert A. Smith et al., "Legislation Raising the Legal Drinking Age in Massachusetts from 18 to 20: Effect on 16 and 17 Year Olds," Journal of Studies on Alcohol, 45:6 (November 1984), 534-39.

[c]Allan F. Williams et al., "The Effect of Raising the Legal Minimum Drinking Age on Involvement in Fatal Crashes," The Journal of Legal Studies, 12 (1983), 169-79.

[d]The study period indicates the overall data collection period. For state-to-state comparisons, the study period varies, depending on the timing of changes in a state's legal drinking age.

In Massachusetts, Smith et al. (1984) compared the responses of 16- to 19-year-olds to a comparable group of New York youths concerning reported alcohol consumption and driving after drinking. In New York, Lillis et al. (1986) and Williams et al. (1983) each co-authored studies that analyzed survey data collected for the youth alcohol study discussed in the previous chapter. Lillis et al. focused their comparisons on the older, 18-year-old group, although they reported changes in rates of driving after drinking for 19- and 20-year-olds. Williams et al. examined the quantity and frequency of alcohol consumption for 17- through 20-year-old youths. Their analysis of 17-year-olds was restricted to before-and-after comparisons of drinking levels for persons younger than the legal age and did not make necessary comparisons with the older age groups not affected by the law.

Smith et al. found that in the period after the law changed, the average amount and frequency of alcohol consumption did not decline significantly for 16- and 17-year-olds in Massachusetts compared to New York. A significant number of Massachusetts teenagers who reported drinking at least once a week declined in the first year after the law and

increased significantly in the second year. There was no significant difference for either year between the two groups in the reported ownership of fake identification.

Where youths younger than the legal age drank and where they obtained alcohol did change after the enactment of the law. In Massachusetts, 16- and 17-year-olds were significantly less likely than teenagers in New York to do the majority of their drinking in bars, clubs, or restaurants, and there was greater decline in the percentage of 16- and 17-year-olds in Massachusetts who purchased alcohol at liquor stores. They were, however, more likely to have others purchase alcohol for them after the law change.

Self-reported driving after any drinking declined significantly for 16- and 17-year-olds in Massachusetts relative to their New York counterparts and was not found among 18- and 19-year-olds. However, driving after heavy drinking (6 or more drinks) did not decline in either age group in Massachusetts relative to New York.

Lillis et al. found that 18-year-olds continued to purchase beer at a significantly greater rate than 17-year-olds after the law change. The 20.1-percent rate of beer purchasing among 17-year-olds before the law change was comparable to the reported purchasing rate of 20.8 percent after the law change. Although arrest rates for driving while intoxicated for 17-year-olds decreased by 18.3 percent following the law change, they also decreased for those legally entitled to drink, 20.3 percent for 19-year-olds and 13 percent for 20-year-olds. Self-reported rates of driving after drinking decreased for 17-year-olds by 18 percent following the law change, compared to a 10-percent decrease for 19-year-olds and a 24-percent decrease for 20-year-olds in New York.

Williams et al. focused on the alcohol consumption patterns among New York youths. In general, they found that all levels of drinking decreased for all ages. Seventeen-year-olds showed significant decreases for heavier levels of drinking after the law change, compared to survey results from before the changes. Although the authors concluded that an older drinking age may cause an incremental reduction for younger age groups not directly affected by the law, the lack of analysis for older comparison groups limits our ability to draw any firm conclusions.

Conclusions

We found the available evidence on alcohol consumption and driving after drinking insufficient to determine the existence of an effect on

youths younger than the legal drinking age. The limited number of studies conducted in two states presented mixed results, and the heavy reliance on survey data may substantially underestimate actual levels of alcohol consumption.

Chapter 6

Other Effects of Minimum Drinking-Age Laws

Questions have been raised about the effect of raising the legal drinking age on other outcomes not mentioned in chapters 3 through 5. Some have argued that individual states may raise their legal drinking age but if other states maintain a lower drinking age, youths younger than this will cross state borders to purchase alcohol where there are no legal restrictions. Questions have also been raised about the long-term effect of raising the legal age. Specifically, Do the short-term effects, reported in chapter 3, hold up over time? Finally, the effects of lowering the legal drinking age and how they compare to the effects of raising the drinking age are considered. Table 6.1 displays the number of studies included in our synthesis and the number that met our minimum threshold criteria.

Table 6.1: Number of Studies on Three Other Topics

	Number of studies		
	Threshold met	Threshold not met	Total
Border crossings	3	3	**6**
Long-term effects	2	0	**2**
Lowering vs. raising the minimum age	1	0	**1**

In this chapter, we review evaluations of these other effects of changes in the law. We also discuss separately the effect of lowered minimum-age laws, as reported in prior reviews of the literature.

The State of Evaluation Research on Border-Crossing Studies

The potential incentive for young drivers to cross state borders to purchase alcohol not legally available within their own states has been referred to as the "border-crossing problem." Federal initiatives to encourage a uniform 21-year-old minimum drinking age were prompted in part by concern over this. Prior to the passage of Public Law 98-363, an estimated 56 percent of the total borders in the United States separated states that had differing legal drinking ages. One plausible reason state legislatures resisted changing their drinking-age laws was the awareness that youths would merely cross state lines to obtain alcoholic beverages. We reviewed 6 studies that evaluated the effects of border crossings. Three were the focus of our evaluation synthesis and are described in table 6.2.

Table 6.2: The Features of Three Studies on Border Crossings

Feature	Hughes and Leung (1985)[a]	Lillis et al. (1984)[b]	Negri (1979)[c]
Study period[d]	1973-81	1978-82	1977
Location	Wisconsin counties bordering Illinois, Iowa, Michigan, and Minnesota	New York counties bordering Massachusetts, New Jersey, and Pennsylvania	New York counties bordering Connecticut, Massachusetts, New Jersey, Pennsylvania, and Vermont
Design characteristics	3 years before and 3 years after	Ratio of percentage of illegal "drinking drivers" to the percentage of licensed drivers affected by the law change[e]	Chi-square analysis of difference for crash rates for out-of-state drivers from states with minimum-age laws
Outcome measure	"Driver had been drinking" crashes	"Driver had been drinking fatal or injury" crashes	All accidents and single-vehicle accidents
Age group affected	Varies by state	Varies by state	Pennsylvania drivers 18 to 20 years old
Controls	Comparison of "drinking drivers" as a percent of all drivers involved in accidents for 8 discrete age groups[e]	Comparison of crash rates for "drinking drivers" to crash rates for those legally entitled to drink; license rate[e]	Comparison of crash rates for out-of-state drivers from states with different minimum-age laws

[a]Dennis J. Hughes and Kam S. Leung, Driver Age and Alcohol-Related Accidents in Wisconsin (Madison, Wisc.: Wisconsin Department of Transportation, Bureau of Policy Planning and Analysis, April 1985).

[b]Robert P. Lillis et al., "Special Policy Consideration in Raising the Minimum Drinking Age: Border Crossing by Young Drivers," paper presented at the National Alcoholism Forum, Detroit, Mich., April 12-15, 1984.

[c]Barry D. Negri, Accidents in New York State Involving Young Drivers from Adjacent States (Albany, N.Y.: New York Department of Motor Vehicles, Division of Research and Development, June 1979).

[d]The study period indicates the overall data collection period. For state-to-state comparisons, the study period varied, depending on the timing of changes in a state's legal drinking age.

[e]"Drinking drivers" who are not entitled to drink legally in their state of residence.

All 3 evaluations we examined restricted their analyses to one side of the border—that is, accidents in the border counties of the state that maintained a lower legal drinking age. These studies focused on New York and Wisconsin, which maintained a lower legal drinking age than neighboring states. Measures of effect varied substantially. Lillis et al. (1984) used police-reported alcohol-involved fatal and personal injury crash data for drivers affected by the law. Negri (1979) compared all accidents and single-vehicle accidents for drivers under 21. His use of less-sensitive measures of alcohol involvement, and his merging of directly affected and younger drivers, rendered the results difficult to interpret. Unlike Negri, Hughes and Leung (1985) used police-reported alcohol-involved accidents as an outcome measure.

Problems with small sample size were reported in the 2 studies that used more direct measures of alcohol involvement. The use of rural counties, differences of only 1 year in the minimum age, and short time periods

between before-and-after measures may all have contributed to the small number of cases. Although Negri reported no such problems, his use of all accidents and a broad definition of who was affected by the law may have minimized problems with sample size while complicating our ability to attribute changes in measures of effect to different drinking-age laws.

The 2 studies that assessed the extent of New York's border-crossing problem suggested there was an effect. Negri (1979) found that drivers younger than the legal age from Pennsylvania were more involved in accidents in New York border counties than their counterparts from adjacent states with lower drinking-age laws. The follow-up evaluation by Lillis et al. of the New York experience found that drivers affected by the law from Massachusetts, New Jersey, and Pennsylvania were over-involved in alcohol-related accidents at rates of 6.2 to 1, 3.6 to 1, and 4.9 to 1, respectively. Data reported on alcohol-related crashes of comparable drivers from states with a purchase age of 18 years produced no major differences.

Hughes' 1985 analysis of "border hopping" for Wisconsin's border states reported mixed results. Accident involvement rates in Wisconsin border counties among out-of-state drivers affected by the law rose for some states and did not change noticeably for others. For Minnesota drivers, "border hopping" was reported as a problem for drivers of all ages.

Although available evidence in New York suggests the presence of a border-crossing problem, our review of the reported results and their limitations leads us to conclude that there is insufficient evidence to assess the extent of a border-crossing problem. Numerous problems were identified among the 3 evaluations we reviewed. These evaluations restricted their analyses to one side of the border and relied on accident data from two states. Differing demographic characteristics, low accident-involvement rates for drivers affected by the law, and incremental changes in age all contributed to making border crossing a difficult concept to measure and evaluate.

Long-Term Effects

A review of other laws designed to deter drinking and driving reported notable declines in associated crashes in the short-term but found that the effects dissipated over time. Two studies met our threshold criteria and evaluated the long-term effects of an older drinking age.

Wagenaar (1984) posited three possibilities regarding the long-term effects of an older drinking age. Assuming a short-term effect has been demonstrated, it may (1) continue unchanged as a permanent reduction in crashes, (2) dissipate over time as young drivers gradually identify alternative sources of alcohol, or (3) become even larger as new cohorts of young drivers emerge that have not developed a pattern of regular drinking and driving after drinking. Wagenaar's analysis of the long-term effects of Michigan's drinking age and DuMouchel's (1985) multi-state evaluation reported that effects were sustained.

Wagenaar followed up his earlier evaluation of the initial effect of Michigan's increased drinking age with an extended time-series analysis of 5 years of data from after the change. Using two different measures of alcohol-involved injury accidents, he reported a long-term reduction of 13.5 percent, compared to a short-term reduction of 19.5 percent.

In a separate analysis of national data on fatal crash involvements, DuMouchel found no evidence of erosion in effects when comparing fatal crash involvements after 1 year and after 3 years of increased drinking ages. To assess whether the effects of a law change persisted over time, DuMouchel employed a modified regression model to evaluate separate estimates of the relative effect of law changes, depending on the number of years a law had been in effect. In states with several years of experience, no significant difference in the effects of the increased purchase age were observed after the first years of the change.

Given the limited number of studies that have assessed long-term effects, the available evidence indicates a generally sustained, significant reduction in alcohol-related injury crashes and fatal crashes, although in one state a modest reduction in the long-term effects was reported. Continuing research, however, is needed to fully understand the nature of the effects as additional states gain experience in the long term with their increased drinking ages.

Effects of Lowering the Minimum Age

Between 1970 and 1975, the minimum drinking age was lowered in 29 states and all the Canadian provinces. We identified more than 30 attempts to evaluate the effects of these changes, and we found that the primary disagreement was not whether there was an effect but, rather, on the size of the effect. (The studies are in the bibliography.)

Although our original objective was to assess the credibility of evaluations of the effect of lowering the drinking age, we found compelling reasons for altering our plan. One of these reasons was the near consensus of results noted above. Another reason was the issue of policy relevance. The current debate is over whether the drinking age should be raised, while the body of literature is directed at the effects of lowering it.

Another reason for not conducting an evaluation synthesis on studies of the effect of lowering the drinking age is that there was a relative lack of data and analytical techniques available during the early 1970's, when minimum-age laws were being lowered. As a result, evaluations on lowered drinking ages tend to be far less sophisticated, from a methodological standpoint, than the research synthesized in prior chapters. Consequently, with the agreement of the subcommittee, we reviewed critiques, rejoinders, and summaries of the literature and offer a "review of the reviews" for evaluations of a lowered minimum drinking age.

Relationship Between Lowered Drinking Age and Traffic Accidents

Most all the reviewers of studies of lowering the drinking age found a clear, inverse relationship between minimum drinking age and alcohol-related crashes. In other words, a decrease in drinking age was associated with an increase in the frequency or rate of crashes. Our review of the critiques, rejoinders, and summaries of the literature on the lowered drinking age typically yielded conclusions such as the following:

- An overwhelming majority of research shows a major problem for young drinking drivers; the problem increases substantially with a lowered age.
- With few exceptions, the sounder research strategies, in spite of their vast methodological and statistical differences, foster the strong inference that lowering the drinking age usually leads to an increase in alcohol-related collisions.
- Young drivers are more involved in alcohol-related traffic collisions.
- Research shows a significant increase in driving accidents among youths 18 to 20 years old.

Some reviewers had reservations about the quality of evaluations and the variability of results by state. Among the methodological weaknesses observed were improper use of comparison areas where the law did not change, inadequate outcome measure of alcohol involvement, and lack of extended longitudinal data bases. However, the strength of

the finding was enhanced by the consistency of results across jurisdictions, despite the varied analytical methods employed.

Effects on Alcohol Consumption and Driving After Drinking

Fewer reviewers found a clear relationship between a lowered minimum drinking age and alcohol consumption or driving after drinking, as opposed to the relationship with regard to crashes. Some typical conclusions we found in reviews of the literature were

- Most studies found increases in reported drinking among youths and increases in alcohol sales, typically beer; however, the evidence is not unequivocal and straightforward.
- Beer is more likely to be implicated than other beverages.
- The largest change was in on-premise consumption.
- States with an older minimum age seem to have better control over drinking and driving among youths.
- Both sales data and self-reported studies suggest an increase in alcohol consumption among youths.

Reviewers had stronger reservations about the quality of research than previously noted for traffic-accident outcomes. Much of this concern focused on the lack of age-specific consumption or alcohol-beverage sales data.

Effects on Younger Nonlegal Drinkers

We found that there is little or no demonstrable effect of a lowered drinking age on younger persons who were never legally able to drink (usually 16 or 17 years old). This conclusion is based on the few number of reviews that address this issue, the inconsistency of their findings, and the relatively weak confidence that reviewers placed in their findings.

Conclusions

Most reviewers found that a lower drinking age had a clear effect on the most important outcome measures, crash and injury, in spite of frequently noted methodological shortcomings. They had less confidence in consumption outcomes and found little, if any, effect on the population group younger than the legal age who were not legal drinkers either before or after the law change.

Comparing the Effects of Lowering and Raising the Legal Drinking Age

Only one study we identified compared the effects of an increased drinking age to the prior effects of a lowered age. Evaluation findings on the effects of decreases in the legal drinking age cannot easily be generalized to the effects of increases in the legal drinking age, because of basic differences in the two initiatives. It is much more difficult to effect a change in personal behavior from an already established pattern—such as prohibiting individuals to purchase alcohol who already have an established drinking habit—than it is to allow an individual to participate in new behavior without having to overcome an existing habit.

However, the one evaluation (Wagenaar, 1981) that compared the effect of a lower legal drinking age to that of an increased legal drinking age in Michigan reported a similar magnitude of effect. Following a reduction in the legal drinking age, Douglas and Freedman (1977) reported a 16.6-percent increase in single-vehicle male nighttime accidents and a 34.6-percent increase in police-reported alcohol-involved accidents for youths 18 to 20 years old. When the drinking age was raised in 1978, Wagenaar evaluated the effect of the change in the law, using a design and measures of effect comparable to those of Douglas. Wagenaar found a 17.7-percent decrease in single-vehicle male nighttime accidents and a 30.7-percent decrease in police-reported alcohol-involved accidents. Although Michigan's results suggest a re-thinking of the proposition that there are basic differences between lowering and raising the legal drinking age, further research is needed to determine how generalizable these findings are.

Request Letter

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October 21, 1985

The Honorable Charles A. Bowsher
Comptroller General of the United States
U. S. General Accounting Office
441 G Street, N. W.
Washington, D. C. 20548

Dear Mr. Bowsher:

It has been brought to my attention that your Program Evaluation and Methodology Division is starting work on an issue that has been of concern to this subcommittee, namely, minimum drinking age laws and their effect on highway safety. I am therefore requesting that the results of that work be addressed to the attention of this subcommittee.

I understand that the initial effort will take the form of an evaluation synthesis which will critically examine existing evaluations to determine the technical and methodological soundness of these evaluations and the credibility of the claims which have been made based upon them. For those studies which seem to offer the most credibility, we would expect a GAO assessment as to the observed range of effects of minimum drinking age laws. Suggested questions or measures in the synthesis are, of course, subject to those employed in the studies reviewed. The following would be of interest to the subcommittee:

-- Does raising or lowering the legal drinking age result in a change in beverage alcohol consumption in the target age group?

-- Does changing the legal drinking age result in a change in alcohol-related motor vehicle fatalities in the target group?

-- Does changing the legal drinking age result in a change in personal injuries associated with alcohol-related motor vehicle crashes in the target age group?

-- Does changing the legal drinking age result in a change in alcohol-related motor vehicle crashes in the target age group?

Other areas of interest which may or may not be SUFFICIENTLY addressed in the literature to warrant inclusion in your synthesis are:

-- What are the effects of differing minimum drinking age laws on the target age groups residing in proximate jurisdictions (so called "blood borders")?

-- What are the displacement effects of changes in minimum drinking age laws on alcohol-related accidents for young drivers not in the target age group? (Of particular interest are the effects of 18 year old minimum age laws on the crash experience of 16 and 17 year old drivers.)

-- What are the long term effects of changes in minimum drinking age laws on the target group (i.e., does the initial effect disappear as in the case of Scandanavian type laws)?

-- How do the effects of lowered legal drinking age laws compare with the effects of raised legal drinking age laws?

-- What is the magnitude of the effect of changes in minimum drinking age laws on the target age group?

Should you find that these questions have not been adequately studied, and your staff is of the opinion that there is adequate information to do so, I would request that GAO follow the synthesis with its own evaluation to provide answers to selected questions not adequately addressed, as well as to respond to knowledge gaps identified during the synthesis.

While this request is directed specifically at the issue of minimum drinking age laws, we have a broader concern that your report may also be able to address. This is the question of what constitutes a "good" evaluation. The subcommittee has for years held hearings on transportation safety issues and notes the frequency with which evaluations that are submitted for the record support opposing conclusions, even though they use similar data bases and assumptions. We would therefore request that your drinking age synthesis include a methodology checklist which we could employ in a broader context to assess the credibility or acceptability of transportation safety evaluations in general.

Honorable Charles A. Bowsher
October 21, 1985
Page Three

I would hope that you would be able to brief us with your preliminary results of the synthesis by late Spring, 1986, followed shortly thereafter by your final report. I would also expect that the second phase of work, the GAO evaluation, could start during the summer of 1986 with a completion date to be agreed upon after the scope of the effort has been adequately defined.

I look forward to the results of this evaluation synthesis and request that your staff coordinate their efforts with my staff engineer, Richard Tearle, at 225-3274.

Sincerely,

James L. Oberstar

James L. Oberstar
Chairman
Subcommittee on
Investigations and Oversight

State Minimum Drinking Ages

Table II.1: State Minimum Drinking Ages by Year of Enactment

State and minimum age	Year of act	Prior age in years
21 years		
California	1933	•
Nevada	1933	•
Indiana	1934	•
New Mexico	1934	•
Washington	1934	•
Oregon	1935	•
Pennsylvania	1935	•
Utah	1935	•
North Dakota	1936	•
Kentucky	1938	•
Missouri	1945	•
Arkansas	1957	•
Michigan	1978	18
Illinois	1980	19
Maryland	1982	18
New Jersey	1982	19
Alaska	1983	19
Delaware	1983	20
Oklahoma	1983	18 for 3.2 beer
Arizona	1984	19
Massachusetts	1984	20
Nebraska	1984	20
Rhode Island	1984	20
Tennessee	1984	19
Alabama	1985	19
Connecticut	1985	18 in 1981; 19 in 1982; 20 in 1983
Florida	1985	19 in 1980
Georgia	1985	19 in 1980; 18 in 1979
Kansas	1985	18 for 3.2 beer in 1949
Maine	1985	20
Mississippi	1985	18 for beer and light wine in 1966
New Hampshire	1985	20
New York	1985	19 for purchase only
North Carolina	1985	19 for beer in 1935
South Carolina	1985	18 for beer and wine in 1935
Texas	1985	18 in 1980; 19 in 1981
Virginia	1985	19 for beer; 18 for on-premise beer
District of Columbia	1986	18 for beer and wine; 21 all other

State and minimum age	Year of act	Prior age in years
21 years		
Hawaii	1986	18
Idaho	1986	19
Iowa	1986	19
Minnesota	1986	19
Vermont	1986	18
West Virginia	1986	19 resident; 21 nonresident
Wisconsin	1986	19
19 years		
Wyoming	1973	18
Montana	1979	18
18 years		
Louisiana	1948	•
Puerto Rico	1969	•
Split		
Colorado	1945	18 for 3.2 beer; 21 all other
Ohio	1982	18 for 3.2 beer; 21 all other
South Dakota	1984	19 for 3.2 beer; 21 all other

Potential Reductions in Federal-Aid Highway Funds for Noncomplying Jurisdictions

The National Highway Traffic Safety Administration and the Federal Highway Administration, which are responsible for determining compliance with the federal drinking-age law, have determined that eight states and Puerto Rico do not comply with the federal legislation. The following, in millions of dollars, are their estimated revenue losses (based on fiscal year 1986 appropriations) in fiscal year 1987, given a 5-percent reduction in federal-aid highway funds:

Puerto Rico, $3.593

South Dakota, $4.152

Wyoming, $4.494

Idaho, $4.508

Montana, $5.595

Tennessee, $8.667[1]

Colorado, $9.133

Louisiana, $15.648

Ohio, $16.330.

The total is $72,120,000.

[1]Tennessee is not in compliance with the national drinking-age legislation because it exempts military personnel.

A Chronology of the Minimum Drinking-Age Issue

January 5, 1933	Ratification of the 21st amendment repealed prohibition and granted the states substantial power to regulate the purchase and possession of liquor within a state.
September 9, 1966	Enactment of the Highway Safety Act of 1966 (Public Law 89-564) provided the first major impetus for federal involvement in drinking and driving by requiring DOT to establish uniform safety standards for state highway safety programs and to provide funds to carry out such programs.
June 1967	DOT issued its "Alcohol in Relation to Highway Safety Standard" (1 of 13 traffic safety standards), to broaden the scope and number of activities directed at reducing alcohol-related accidents.
1970	NHTSA established a special office of alcohol countermeasures and the alcohol safety action program in 1970-71.
July 1971	Ratification of the 26th amendment, extending the right to vote to 18-year-olds, helped prompt 29 states to lower their minimum drinking ages in the early 1970's.
1973	NHTSA agreed by contract with the University of Michigan Highway Safety Research Institute to scientifically analyze the effects of lowering the legal drinking age from 21 to 18 on youths involved in crashes. The report showed a 10-percent to 26-percent increase in crash involvement between 1968 and 1971.
January 2, 1974	Enactment of the Emergency Highway Energy Conservation Act (Public Law 93-239), spearheaded by a member of the Congress from New Jersey, temporarily established a nationwide speed limit of 55 miles per hour. The law relied on crossover sanctions to encourage the states to conform to the act.
January 4, 1975	Enactment of the Federal-Aid Highway Amendments Act of 1974 (Public Law 93-643) made the 55-mile-per-hour speed limit permanent.

	Studies showed that a decline in traffic fatalities could, in part, be attributed to lower speed limits.
1976	From this year on, no state lowered its drinking age, partly because of empirical evidence that suggested a link between lowering the drinking age and increased traffic fatalities.
April 14, 1982	The president appointed a 32-member commission to study the national problem of drunk driving.
April 27, 1982	H.R. 6170 was introduced by members of the Congress from New Jersey and Maryland and others to encourage the states to strengthen programs to control drunk driving.
April 29, 1982	The House Subcommittee on Surface Transportation held hearings on H.R. 6170; the legislation was generally supported by both the beverage and insurance industries.
May 12, 1982	H.R. 6170 was incorporated into H.R. 6211, which became the Surface Transportation Assistance Act of 1982.
July 22, 1982	The National Transportation Safety Board recommended a national minimum drinking age of 21.
September 29, 1982	The House of Representatives unanimously approved H.R. 6170 by voice vote.
October 1, 1982	The Senate unanimously approved its counterpart bill to H.R. 6170, and the bill was sent to the president.
October 15, 1982	A joint resolution (S.J. Res. 241) providing for a National Drunk and Drugged Driving Awareness Week was signed into law as Public Law 97-343.

October 25, 1982	Enactment of H.R. 6170 as the Alcohol Traffic Safety and National Driver Registration Act (Public Law 97-364) provided for a two-tier incentive grant program to improve traffic safety. The Congress mandated that the secretary of the Department of Transportation would consider a state minimum drinking age of 21 as one criterion to be met for supplemental grants.
November 30, 1982	House and Senate resolutions were introduced on the legal minimum age for drinking and the purchase of alcohol.
December 13, 1982	The Presidential Commission on Drunk Driving recommended a uniform minimum drinking age of 21 in an interim report intended to allow state legislatures time to consider this recommendation early in their 1983 sessions.
January 6, 1983	The Surface Transportation Assistance Act of 1982 (Public Law 97-424) contained a small section (section 209) strongly encouraging the states to raise the minimum drinking age to 21. On the day the law was enacted, House Concurrent Resolution 23 was introduced by a member of the Congress from Pennsylvania, expressing the sense of the Congress that all states should establish a minimum drinking age of 21.
January 27, 1983	A Gallup poll showed that 77 percent of Americans supported a uniform drinking age of 21 for all states.
February 7, 1983	NHTSA's announced criteria for awarding basic and supplemental incentive grants to states under Public Law 97-364 included, as criteria, raising the minimum age drinking for all alcoholic beverages to 21.
April 7, 1983	H.R. 2441 was introduced by a member of the Congress from Illinois to prohibit the use of federal highway funds by states whose minimum drinking age was lower than 21.
April 20, 1983	Senators from Missouri, Oregon, and Rhode Island introduced S. 1108, the Highway Safety Act of 1983, which provided more incentive grants

	to states for efforts to deter drunk driving. The bill was never voted out of committee.
April 21, 1983	A member of the Congress from California introduced H.R. 2693, a counterpart bill to S. 1108.
May 6, 1983	A Senator from Pennsylvania introduced Concurrent Resolution 32 to express the sentiment of the Congress that all states should establish a minimum drinking age of 21.
September 13, 1983	A member of the Congress from New Jersey and others introduced H.R. 3870, a bill to prohibit the sale of alcoholic beverages to persons under 21 years of age under certain conditions.
October 1983	A Senator from Indiana introduced S. 1948 as a counterpart to H.R. 3870.
October 4, 1983	The House Subcommittee on Commerce, Transportation, and Tourism held hearings on H.R. 3870. At the hearings, the beverage industry questioned the constitutionality of legislation to prohibit the sale of alcoholic beverages to persons under 21 years of age.
November 1983	The Presidential Commission on Drunk Driving issued its final report, keeping the recommendation for a uniform minimum drinking age of 21 for the purchase and public possession of all alcoholic beverages.
January 1984	The National Safety Council supported the formation of an organization to follow up on the work of the Presidential Commission, called the National Commission Against Drunk Driving. Also, the president publicly rejected the support of the Presidential Commission on Drunk Driving for a uniform minimum drinking age of 21.
January 24, 1984	A member of the Congress from California and others introduced H.R. 4616, a bill to amend the Surface Transportation Assistance Act of 1982 by increasing appropriations for highway safety and requiring that at

	least 8 percent of these funds be used to implement a comprehensive child-restraint system in motor vehicles.
February 7, 1984	Senators from New Jersey, North Dakota, and Rhode Island introduced S. 2263, the Uniform Minimum Drinking Age Act, to amend the Surface Transportation Assistance Act of 1982 by reducing the amount of federal highway aid for states that do not enact a legal minimum drinking age of 21.
February 22, 1984	Members of the Congress from Florida and Maryland introduced H.R. 4892, a counterpart to S. 2263.
February and March 1984	The House Subcommittee on Surface Transportation held hearings on surface transportation issues, which included a discussion of the drinking-age issue on February 22 and 23.
April 5, 1984	A member of the Congress from New Jersey and others introduced H.R. 5383, a bill to reduce a state's apportionment for federal aid for highways by specific percentages in specific fiscal years for states with drinking ages below 21.
April 25, 1984	A member of the Congress from California introduced H.R. 5504, the Surface Transportation and Uniform Relocation Assistance Act of 1984.
April 30, 1984	The House passed H.R. 4616 by voice vote.
May 24, 1984	Senators from New Jersey and Rhode Island introduced S. 2719 as a revision of S. 2263, a counterpart to H.R. 5383, and an attachment to H.R. 4616, the Child Safety Restraint Act.
June 7, 1984	The House approved H.R. 5383 as an amendment to H.R. 5504, which would reduce federal highway funds by 5 percent in fiscal year 1987 and 10 percent in fiscal year 1988 for states not enacting a minimum drinking age of 21.

June 13, 1984	The administration reversed its position on the minimum drinking-age issue through support of H.R. 4616 from the secretary of the Department of Transportation.
June 14, 1984	The Senate Subcommittee on Surface Transportation held hearings on measures to combat drunk driving.
June 19, 1984	The Senate Subcommittee on Alcoholism and Drug Abuse held hearings on a national minimum drinking age.
June 26, 1984	The Senate passed S. 1948 by a vote of 81-16, as an attachment to H.R. 4616, with the inclusion of additional incentive grants dealing with sentencing laws and improved automated records of accidents. The Senate then passed its version of H.R. 4616 by a voice vote.
June 27, 1984	The House cleared the Senate version of H.R. 4616, including H.R. 5383.
July 6, 1984	The Senate version of H.R. 4616 was approved and sent to the president.
July 17, 1984	The Child Safety Restraint Act (H.R. 4616), which included legislation for a national minimum drinking age of 21, was signed into law (Public Law 98-363) amending the Surface Transportation Assistance Act of 1982. This act was strongly lobbied for by the Mothers Against Drunk Driving, the Parent Teachers Association, the National Safety Council, the National Council on Alcoholism, and the insurance industry.
September 21, 1984	South Dakota brought an action against the secretary of the Department of Transportation in the U.S. District Court for the District of South Dakota, asking the court to declare the uniform national drinking age sanction of the Surface Transportation Assistance Act of 1982 unconstitutional, on the grounds that it violated the 10th and 21st amendments of the U.S. constitution.

February 20, 1985	A member of the Congress from Virginia introduced H.R. 1180, a bill to make the minimum drinking age on military bases in a state the same as the state's. This bill was referred to the Committee on Armed Services and later amended to the Department of Defense Authorization Act on June 21, 1985.
March 21, 1985	A member of the Congress from Vermont introduced H.R. 1664 and H.R. 1665, bills to authorize states, under the national minimum drinking-age provision, that are adjacent to other states or a foreign country (as in H.R. 1665) to allow 18-, 19-, or 20-year-olds to purchase and consume alcoholic beverages on the premises of specific establishments. These bills were referred to the Committee on Public Works and Transportation.
May 3, 1985	The U.S. District Court issued a memorandum opinion and judgment dismissing the South Dakota case against the national drinking-age legislation.
May 16, 1985	Members of the Congress from Louisiana and Vermont introduced H.R. 2537 to apportion federal highway funds withheld from states for failing to establish a minimum drinking age of 21 if certain alcohol-related traffic fatalities are significantly reduced. The bill was referred to the Committee on Public Works and Transportation.
June 3, 1985	A member of the Congress from Louisiana introduced H.R. 2645 to repeal the national minimum drinking-age law. The bill was referred to the Committee on Public Works and Transportation.
June 26, 1985	South Dakota appealed the District Court's decision to the Court of Appeals for the Eighth Circuit, contending again that the 10th and 21st amendments were violated by the national drinking-age legislation. Nine other noncomplying states supported South Dakota's appeal.
July 11, 1985	Senators from Missouri and New Jersey introduced S. 1428, to make permanent the withholding of 10 percent of the apportionment from the

	Highway Trust Fund to states that have not adopted the national minimum drinking age. The bill was referred to the Committee on Environment and Public Works.
September 27, 1985	NHTSA and the Federal Highway Administration issued a notice of proposed rulemaking to implement section 6 of Public Law 98-363 (section 6 refers to the withholding of federal-aid highway funds).
November 12, 1985	S. 1428 was amended to S. 1730, the Consolidated Budget Reconciliation Act.
December 20, 1985	S. 1730 was folded into H.R. 3128, the Budget Reconciliation Act, which did not pass but was carried over into the next year.
April 7, 1986	The president signed the Budget Reconciliation Act, which made permanent the withholding of 10 percent of federal highway funds from states refusing to comply with a uniform drinking age.
May 21, 1986	The court of appeals for the eighth circuit affirmed the district court's dismissal of South Dakota's complaint challenging the constitutionality of the national drinking-age legislation.
July 25, 1986	The Department of Transportation determined that the drinking-age laws of eight states and Puerto Rico were not in compliance with the national drinking-age law legislation.

The Relationship Between the Questions We Posed and the Evaluations We Synthesized

Table V.1: The Coverage of Our Principal Topics by 49 Independent Studies[a]

Study	Traffic accidents	Consumption and driving after drinking	Effects on other youths	Border crossing	Other effects
Arnold, 1985	•				
Barsby, 1985		•			
Birkley, 1983a	•				
Birkley, 1983b	•				
Birkley, 1985	•				•
Bollotin, 1983	•	•			
Bollotin and Desario, 1985	•				
Bond and Jones, 1981	•				
Choukroun, 1985	•				
Coate and Grossman, 1985		•			
Colon, 1984	•				
DuMouchel, 1985	•				•
Dunham and Detmer, 1983			•		•
Emery, 1983	•				
Fleming, 1983				•	
Florida, 1983	•		•		
Georgia, 1985	•				
Grossman, 1984		•			
Hingson, 1983	•	•			
Hoskin, 1986	•				
Hughes and Leung, 1985			•		
Hughes and Leung, 1986	•				
Klein, 1981	•		•		
Lillis, 1984				•	
Lillis, 1986	•	•	•		
Lonnstrom, 1984					•
Lynn, 1984	•				
Males, 1986a	•				
Males, 1986b	•				
Maxwell, 1981	•		•		
McCornac, 1982				•	
NHTSA, 1982	•				
Negri, 1979				•	
New Jersey, 1984	•				

Study	Traffic accidents	Consumption and driving after drinking	Effects on other youths	Border crossing	Other effects
Perkins, 1985		•			
Rooney, 1977		•			
Roy and Greenblatt, 1979					•
Saffer and Grossman, 1985	•				
Schroeder and Meyer, 1983	•				
Schweitzer, 1983		•			
Smith, 1984			•		
Sommers, 1985	•				
Texas, 1982	•		•		
Vingilis and Smart, 1981	•	•			
Wagenaar, 1981	•		•		•
Wagenaar, 1984	•	•			
Williams, 1983	•		•		
Williams, 1985		•			
White, 1986				•	

[6]Full bibliographical data appear in the bibliography at the end of this report.

Our Study Search Procedures and Methodology

Our objectives were to assess the technical and methodological soundness of evaluations of drinking-age laws and determine the extent to which they provide empirical support for federal and state initiatives to raise the legal drinking age. The general evaluation synthesis methodology that we used has three main features:

- It attempts to include all relevant empirical work, including unpublished and draft manuscripts.
- It considers findings across studies as well as the quality of the research methodologies and source data.
- It provides an indication of what is known, what is unclear, and where the knowledge gaps are.

Document Search Strategy

Because our objective was to identify all available documentation on the effects of drinking-age laws, we cast a broad net in an attempt to find not only the most frequently cited published work but also unpublished evaluations conducted by state and local governments, independent researchers, and other research organizations.

Our approach to identifying relevant documents was three-pronged and was made up of an examination of computerized bibliographic files, surveys of alcohol and highway safety officials, and personal interviews with experts in the field. We began with a broad-based search of relevant bibliographic retrieval systems, including the Congressional Research Service Bibliographic Reference File, National Clearinghouse for Alcohol Information Abstracts, National Criminal Justice Reference Service, Scorpio Information Retrieval System, Transportation Research Information Service, and sociological, psychological, social science, and insurance research abstracts.

To minimize publication bias and maximize the likelihood of collecting as complete a compilation of evaluations as possible, we surveyed state highway safety officials, state alcohol and drug abuse directors, researchers, and other officials knowledgeable about alcohol and highway safety.

We sent an initial questionnaire (shown in appendix VII) to 114 state alcohol and highway safety officials and asked them to identify evaluations and reports that had been completed in their states on the effects of the legal drinking age. We used the results of the survey, combined with documents retrieved in our bibliographic searches, to construct a preliminary bibliography of evaluations of minimum-age laws.

We then sent a bibliography of the evaluations we had identified to researchers and knowledgeable others to uncover other work that we might have missed. We asked them to review our bibliography and identify other reports and sources of information that could be of use. As shown in table VI.1, most of the respondents completed our brief questionnaires. The results of the surveys yielded more than 80 documents of relevance, including 22 evaluations not previously identified.

Table VI.1: Response Rates to Our Survey of Minimum Drinking-Age Law Evaluations

Respondent group	Number	Response rate
Highway safety officials	57	93%
Alcohol and drug abuse officials	57	91
Researchers and other experts	55	78

Our efforts to identify pertinent literature yielded more than 400 reports of direct relevance. We scanned all the documents and classified them into six categories: evaluations of changing the legal drinking age, critiques and summaries of the literature, state and federal legislation, information systems and measurement issues, documents related to drinking and driving, and other alcohol and highway safety reports. We crossindexed critiques and summaries of evaluations to all studies of drinking-age laws, considering them an independent source of information for rating purposes.

The focus of our synthesis was on the 49 studies that examined increases in the legal drinking age. Studies and literature reviews concerned with lowering the drinking age were considered separately and are discussed in chapter 6. Although we collected more than 49 studies, we found that some authors published the same study in a modified form several times. Further, some studies assessed more than one question. For example, an evaluation that analyzed survey data reported results for both alcohol consumption and driving after drinking. In appendix V, we have arrayed the studies we reviewed by the evaluation questions they addressed.

Our third approach to identifying relevant documents involved personal interviews at NHTSA and the University of Michigan and visits to their libraries, where we crosschecked our growing bibliography of highway safety literature with their holdings and collected additional materials. We also conducted interviews with officials from the Insurance Institute for Highway Safety, the National Center for Statistics and Analyses and

the office of alcohol countermeasures at NHTSA, the National Transportation Safety Board, and the U.S. Brewers Association.

Rating Criteria and Procedures

A review panel of GAO staff and independent experts was formed to develop rating criteria and review studies of direct relevance. Because no universally agreed upon rating criteria existed, we developed the criteria shown in appendix VIII, basing them on a preliminary review of the literature and prior evaluation syntheses. We considered the characteristics of the studies—for example, measures used, questions examined, the nature of the law change, and designs employed—in refining existing criteria for purposes of examining the specific literature we were reviewing.

The panel developed criteria for two generic types of studies: cross-sectional studies, comparing two or more defined groups for a single point in time, and before-and-after studies, comparing groups at two or more points in time. We rated all studies in terms of (1) the existence and adequacy of comparison groups, (2) the source data used, (3) the appropriateness and comparability of measures used, (4) the appropriateness of methods for taking chance into account, and (5) the extent to which a study controlled for other factors and provided quantitative measures of difference. For before-and-after studies, we also looked for (6) data that were comparable and (7) controls for the nonindependence of measures.

To critically assess the methodological quality of the 49 evaluations, three raters reviewed each study independently. They were asked to identify the study questions—effects on consumption, fatal crash involvement, and so on—addressed in the evaluation and, for each question, to rate the study against appropriate criteria. The raters then gave an overall rating of acceptable, questionable, or unacceptable for each study question. An unacceptable rating was typically given to studies failing to meet two or more criteria.

After independently rating each study, the panel met to discuss its strengths and weaknesses and reconcile differences in individual ratings. The studies that contained no serious flaws or were flawed but of sufficient quality to inform policy were grouped by study question for more in-depth reviews. Among the 49 studies we reviewed, 28 did not meet our threshold criteria. Table VI.2 summarizes the ratings for these studies against the seven criteria.

Table VI.2: Reasons for Unacceptable Study Ratings

Criterion	Traffic accidents	Consumption and driving after drinking	Effects on other youths	Other effects	Total
Comparison group comparability	14	4	0	7	**25**
Description of source data	7	0	0	0	**7**
Comparable measures	8	5	0	3	**16**
Test for significance	14	1	2	5	**22**
Quantitative measure of difference	18	5	2	8	**33**
Comparable before- and-after data	5	0	1	1	**7**
Account for nonindependent observations	4	0	0	0	**4**
Total[a]	**70**	**15**	**5**	**24**	**114**

[a]Totals do not equal the 28 studies judged unacceptable, since most of these studies failed to meet two or more criteria and some studies dealt with more than one outcome.

For some studies, a failure to meet one criterion led to an unacceptable rating for others. For example, the most frequently cited shortcoming was a failure to adequately quantify the degree of effect that could be directly attributable to a change in the legal drinking age. Many of these studies did not adequately take chance into account by employing appropriate statistical tests, which is a prerequisite for linking changes in measures of effect to a change in the law.

Another of the more commonly cited limitations concerned inappropriate comparisons. Several studies merged data from age groups not directly affected by the purchase-age policy with data for those directly affected (the experimental group) by the law. In rating studies that merged the directly affected age group with other age groups, the panel assessed the quality of the evaluation design in one of two ways. If the experimental group included individuals in age groups older than the age to which the purchase age had been increased, this group was considered to be contaminated, rendering the results essentially uninterpretable. When age groups that were directly below the youngest group to be affected by the increase in the purchase age yet old enough to be drivers (for example, drinking drivers) were included in the experimental group, the panel considered the results and reported them as probably attenuated by the inclusion of individuals who were only indirectly affected by an increase in the purchase age.

Once the rating process was complete, the panel members reviewed the studies in groups by study question, in order to assess what was known concerning that question, how confident they were about the available evidence, how adequate the information was, and what knowledge gaps remained. While the initial phases of the review process focused on the strengths and weaknesses of individual studies, during this phase we focused on the quality and quantity of evidence across studies. Only studies that met our minimum threshold criteria were used to assess what was known about the effects of the law change.

In synthesizing the results of our analysis for each study question, we looked for patterns in the study findings, possible limitations in measures used and comparisons made, and the ability to generalize the results. We also considered the quantity of the evidence and whether it accumulated from study to study. In this way, we assessed both quality and quantity in order to determine the strength of evidence for each of the subcommittee's questions.

Strengths and Limitations of Our Method

An evaluation synthesis necessarily depends on the amount of information available and the quality of the evaluations reviewed. We relied on information obtained from books and journals, dissertations, state and federal government agencies, and industry-sponsored studies. Some of the reports were less than complete. The time restrictions for our review did not allow us to contact all authors to clarify ambiguities, request additional information, or obtain primary data. Therefore, we relied primarily on information as it was reported in the published and unpublished sources we examined.

It is possible that we did not uncover all the available documents, but our intensive bibliographic search and survey of experts suggest that any gap is narrow. We believe that we have identified the documentation for all the major, completed evaluation studies of minimum drinking-age laws.

Some evaluation questions can be answered only by looking across several studies, and one strength of our method is that it supplies a systematic way of doing this. In considering the findings of different studies while accounting for the quality and quantity of evidence for each specific question, we were able to provide an indication of what is known, what is unclear, and what questions remain unanswered. An additional advantage of the evaluation synthesis method is that it establishes an

easily accessible base of knowledge, which can be used in assessing future evaluation questions.

Our Data Collection Instruments

This appendix reprints two questionnaires. We sent the first to state alcohol and highway safety officials, asking them to identify documents. We sent the second, after we received responses to the first questionnaire, to researchers and others, asking for supplementation of our initial bibliography.

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

PROGRAM EVALUATION
AND
METHODOLOGY DIVISION

Dear

The General Accounting Office (GAO), an agency of the U.S. Congress, has been asked by the House Subcommittee on Investigations and Oversight of the Committee on Public Works and Transportation to analyze past studies of minimum legal drinking age laws. In order to make our review complete, we need assistance from concerned individuals and experts to insure that we have identified all studies which assess the effects of either increases or decreases in the legal drinking age.

Enclosed are a brief questionnaire and list of studies we have identified. The questionnaire describes the scope of our review and asks for your assistance in identifying studies not on our list. We are interested in any study you believe is relevant without regard to how old it is. If you have an extra copy of any report you identify, we would appreciate receiving one. We ask that you complete and return the questionnaire even if you believe that our list is complete.

Obviously, if time had permitted, we would have preferred to talk with you personally. However, the Subcommittee's request places us under strict time constraints. We hope that you understand and we ask that you provide us with information on studies with which you are familiar within 10 working days. Your timely response will reduce the amount of time we have to expend on followup telephone calls to those unable to respond in this time period. If you have any questions about our request don't hesitate to call Thomas Laetz at (303) 964-0080 or Phillip Travers at (202) 275-2932.

Thank you for your cooperation in this important matter.

Sincerely,

Richard T. Barnes
Project Director

U.S. GENERAL ACCOUNTING OFFICE

IDENTIFICATION OF STUDIES OF STATE
MINIMUM DRINKING AGE LAWS

INTRODUCTION/BACKGROUND

The U.S. General Accounting Office has been asked to assess past evaluations of minimum drinking age laws and to determine the extent to which they provide empirical support for federal and state initiatives to raise the legal drinking age. Evaluation issues of interest include the initial legislative effects on beverage alcohol consumption for the target age group (typically 18-20 year olds) and subsequent effects on alcohol related crashes, injury accidents, and traffic fatalities. Studies which address other outcomes, such as effects on border crossings and long term effects will also be reviewed where sufficient information is available.

The purpose of this questionnaire is to obtain information concerning evaluations/reports of which you are aware. Please list any evaluations/reports involving your state which relate to this important topic, in the spaces provided. If you have a copy of any listed report please send it to the address noted on the enclosed envelope. In the event the envelope is misplaced, please send the questionnaire and any available reports to:

Mr. Thomas Laetz
U.S. General Accounting Office
Suite 300-D
2420 West 26th Avenue
Denver, Colorado 80211

If you have any questions, please call, collect, either Thomas Laetz at (303) 964-0080 or Phillip Travers at (202) 275-2932.

STUDIES OF MINIMUM AGE LAWS

1. Are you aware of any studies conducted in your state which address the issue of minimum drinking age? (CHECK ONE. WE ARE INTERESTED IN ALL RELEVANT STUDIES WITHOUT REGARD TO WHEN THEY WERE PRODUCED.)

   1. [ ] Yes (CONTINUE)

   2. [ ] No (SKIP TO Q. 3)

2. Please use the space below to provide us with information about the studies you are aware of that have been conducted in your state. (UNDER ORGANIZATIONAL CONTACT LIST THE NAME, ADDRESS AND TELEPHONE NUMBER OF AN ORGANIZATION OR INDIVIDUAL WE CAN CONTACT FOR FURTHER DETAILS. IF YOU WOULD LIKE TO PROVIDE US WITH INFORMATION RELATED TO MORE STUDIES THAN WE HAVE PROVIDED SPACE FOR, PLEASE ATTACH ADDITIONAL SHEETS AND USE THE SAME FORMAT.)

(A) Author(s): _____

_____

Title: _____

_____

Date of report: _____

Organizational contact:

Name: _____

Address: _____

_____

Telephone number: _____

-1-

(B) Author(s): _____

_____

Title: _____

_____

Date of report: _____

Organizational contact:

Name: _____

Address: _____

_____

Telephone number: _____

(C) Author(s): _____

_____

Title: _____

_____

Date of report: _____

Organizational contact:

Name: _____

Address: _____

_____

Telephone number: _____

3. Would you like to receive a copy of our study when it is complete? (CHECK ONE)

1. [__] Yes

2. [__] No

If yes, to what address should we mail it?

_____

_____

_____

GENERAL COMMENTS

4. If you'd like to comment on our search for studies or any other matters related to the minimum drinking age, please use the space below. (ATTACH ADDITIONAL SHEETS IF NECESSARY.)

-2-

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

PROGRAM EVALUATION
AND
METHODOLOGY DIVISION

Dear

The General Accounting Office (GAO), an agency of the U.S. Congress, has been asked by the House Subcommittee on Investigations and Oversight of the Committee on Public Works and Transportation to analyze past studies of minimum legal drinking age laws. In order to make our review complete, we need assistance from experts, like you, in identifying studies which assess the effects of either increases or decreases in the legal drinking age. Our enclosed questionnaire describes the scope of our review and asks for your assistance in identifying studies of minimum age laws involving your state. We are interested in any study you believe is relevant without regard to how old it is. If you have a copy of any report you identify, we would appreciate receiving one.

Obviously, if time had permitted, we would have preferred to talk with you personally. However, the Subcommittee's request places us under strict time constraints. We hope that you understand and will be able to provide us with information on studies with which you are familiar by December 9, 1985. If you have any questions about our request don't hesitate to call Thomas Laetz at (303) 964-0080 or Phillip Travers at (202) 275-2932.

Thank you for your cooperation in this important matter.

Sincerely,

Richard T. Barnes
Project Director

U.S. GENERAL ACCOUNTING OFFICE

IDENTIFICATION OF STUDIES OF STATE MINIMUM DRINKING AGE LAWS

INTRODUCTION/BACKGROUND

The U.S. General Accounting Office has been asked to assess past evaluations of minimum drinking age laws and to determine the extent to which they provide empirical support for federal and state initiatives to raise the legal drinking age. Evaluation issues of interest include the initial legislative effects on beverage alcohol consumption for the target age group (typically 18-20 year olds) and subsequent effects on alcohol related crashes, injury accidents, and traffic fatalities. Studies which address other outcomes, such as effects on border crossings and long term effects will also be reviewed where sufficient information is available.

The purpose of this questionnaire is to obtain information concerning evaluations/reports which we have not identified on the attached list. Please review our listing of studies and complete this brief questionnaire.

If you have a copy of any report you list, please send it to the address noted on the enclosed envelope. In the event the envelope is misplaced, please send the questionnaire and any available reports to:

Mr. Thomas Laetz
U.S. General Accounting Office
Suite 300-D
2420 West 26th Avenue
Denver, Colorado 80211

If you have any questions, please call, collect, either Thomas Laetz at (303) 964-0080 or Phillip Travers at (202) 275-2932.

STUDIES OF MINIMUM AGE LAWS

1. Are you aware of any studies not identified on the attached list which address the issue of minimum drinking age? (CHECK ONE. WE ARE INTERESTED IN ALL RELEVANT STUDIES WITHOUT REGARD TO WHEN THEY WERE PRODUCED.)

   1. [ ] Yes (CONTINUE)

   2. [ ] No (SKIP TO Q. 3)

2. Please use the space below to provide us with information about other studies of which you are aware. (UNDER ORGANIZATIONAL CONTACT LIST THE NAME, ADDRESS AND TELEPHONE NUMBER OF AN ORGANIZATION OR INDIVIDUAL WE CAN CONTACT FOR FURTHER DETAILS.)

(A) Author(s): _____

_____

Title: _____

_____

Date of report: _____

Organizational contact:

Name: _____

Address: _____

_____

Telephone number: _____

B) Author(s): _____

_____

Title: _____

_____

Date of report: _____

Organizational contact:

Name: _____

Address: _____

_____

Telephone number: _____

C) Author(s): _____

_____

Title: _____

_____

Date of report: _____

Organizational contact:

Name: _____

Address: _____

_____

Telephone number: _____

3. Would you like to receive a copy of our study when it is complete? (CHECK ONE)

1. [__] Yes

2. [__] No

If yes, to what address should we mail it?

_____

_____

_____

GENERAL COMMENTS

4. If you'd like to comment on our search for studies or any other matters related to the minimum drinking age, please use the space below. (ATTACH ADDITIONAL SHEETS IF NECESSARY.)

-2-

Our Summary Rating Sheet

SUMMARY RATING SHEET

STUDIES ON THE EFFECT OF MINIMUM DRINKING AGE LAWS

1) Study/Code _____

2) Lead Author _____

3) Reviewer _____ 4) Date Review _____

5) Study Question: (A) _____ 6) Overall Rating: _____

(B) _____ Explain Q or N in #8 _____

(C) _____ _____

(D) _____ _____

7) Specific Rating Criteria/Question

	A	B	C	D
Comparison Group				
Source Data				
Compatible Measures				
Test of Significance				
Quantitative Measure of Difference				
Comparable Pre/Post Data				
Account Non-Independence				

8) General Remarks: _____

SPECIFIC COMMENTS FOR STUDY _____

QUESTION _____

REVIEWER _____

DATE _____

Criteria	Rating A	Rating Q	Rating U	Comments
COMPARISON GROUP COMPARABILITY (same age groups, demographics, denominators)				
DESCRIBE DATA SOURCES (change over time in reporting criteria, thresholds, data collection procedures)				
COMPARABLE MEASURES (identical? same surrogate? only fatals (cell size), same time period?)				
TAKE CHANCE INTO ACCOUNT (explicitly)				
QUANTITATIVE MEASURE OF DIFFERENCES (netting-out other causes)				
FOR TIME SERIES/LONGITUDINAL STUDIES				
COMPARABLE PRE AND POST INTERVENTION DATA ('74 and '79, or other interventions dealt with?)				
ACCOUNT FOR NON-INDEPENDENCE (auto correlation, seasonality, cyclical effects, non-effected age groups)				

Comments From the Department of Transportation

U.S. Department of Transportation

Assistant Secretary for Administration

400 Seventh St., S.W.
Washington, D.C. 20590

OCT - 2 1986

Mr. J. Dexter Peach
Director
Resources, Community and Economic
Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

Enclosed are two copies of the Department of Transportation's comments concerning the U.S. General Accounting Office draft report entitled, "Drinking Age Laws: An Evaluation Synthesis of Their Impact on Highway Safety."

Thank you for the opportunity to review this report. If you have any questions concerning our reply, please call Bill Wood on 366-5145.

Sincerely,

Jon H. Seymour

Enclosures

DEPARTMENT OF TRANSPORTATION REPLY

TO

GAO DRAFT REPORT OF AUGUST 29, 1986

ON

DRINKING AGE LAWS:

AN EVALUATION SYNTHESIS OF THEIR IMPACT ON HIGHWAY SAFETY

JOB CODE 973201

SUMMARY OF GAO FINDINGS AND RECOMMENDATIONS

This review was conducted at the request of the Chairman of the Subcommittee on Investigations and Oversight, House Committee on Public Works and Transportation. GAO examined the technical and methodological soundness of existing drinking age evaluations to determine the extent to which they support Federal and State initiatives to change the legal drinking age. In addition, the Committee asked GAO to report on the effects that raising the minimum drinking age have had on:

-- traffic accidents (i.e., motor vehicle fatalities, personal injuries, and alcohol-related crashes);

-- beverage alcohol consumption, along with driving after drinking; and

-- other related effects, such as spillover to underage youth, border crossings to States with lower drinking ages, permanence of effects, comparisons of the results of lowering versus raising the drinking age, and earlier effects of lowering the drinking age.

GAO found that a reduction in traffic accidents for affected age groups is, in fact, attributable to raising the drinking age. Almost all studies found statistically significant reductions in traffic accident outcomes, even though the studies often varied in scope, design, analysis methods, and outcome measures.

GAO found only limited evidence to support conclusions regarding the spillover effects of the law change on the crash experiences, consumption, and driving after drinking practices of underage youth who are only indirectly affected by an increase in the drinking age. They did find some evidence of no spillover effect on crash experiences for this group; however, GAO states that generalizations are impeded by the small number of studies that explicitly tested for this effect (two out of six studies that met GAO's criteria) and the limited number of States studied. The three studies of consumption and driving after drinking practices for this age group presented mixed results.

GAO also found insufficient evidence to assess the extent of the border crossing effect, that is, youth moving between States to legally obtain alcoholic beverages. In addition, they found insufficient evidence to support drawing conclusions on the permanence of any effect of the law change (longer than 3 years) and the effects of lowering versus raising the drinking age. GAO reports that there were just two studies addressing long-term effects that met their criteria; one national study observed a sustained reduction in crash experiences for affected age groups, but the other State study found a modest reduction in long-term crash trends. There was only one study that actually compared the effects of lowering versus raising the drinking age and it found a comparable reverse effect. That is, when the drinking age was lowered, traffic accidents increased at a rate that was similar to the rate of decrease when the purchase age was raised. GAO's assessment of the effects of lowering the drinking age in contrast to raising the drinking age, was based on an analysis of the literature reviews of these studies, which concluded that an increase in traffic accident outcomes could be attributed to a lowered drinking age.

This report contained no recommendations.

DEPARTMENT OF TRANSPORTATION POSITION STATEMENT

The draft report is basically a review of the literature on Drinking Age Laws and it provides an excellent evaluation and synthesis of a number of the existing studies. The report is well written and makes a definite statement that there is a correlation between drinking age and safety. GAO states "...raising the drinking age has a direct effect on reducing traffic accidents among affected age groups (typically 18-20 year olds)...." "The evidence...supports the finding that States can generally expect reductions in their traffic accidents...."

We have no objections to the publication of this report. In fact, we commend GAO for an excellent report which validates our data. We would, however, like to offer the following comments for consideration.

The scope of the literature search includes the major sources of research literature supplemented by a questionnaire which revealed additional sources not encountered in the document search. It appears that the documents reviewed cover the subject most adequately and include most of the major research and analysis both for and against raising the legal drinking age.

There are at least two recent studies not included, these are:

- P. Asch and D. Levy, "Does the Minimum Drinking Age Affect Traffic Fatalities?" Department of Economics, Rutgers University, 1986

- P. Hoxie and D. Skinner, "A Statistical Analysis of the Effects of a Uniform Minimum Drinking Age," Transportation Systems Center Report No. FR-45-U-NHT-06-00, November 1985.

While it is too late to include these studies in the GAO's review, it would be useful to include a statement in the report to the effect that: "All studies available as of October 31, 1985, were reviewed." A list of more recent studies that were not reviewed could also be included.

Now p. 28

The draft report lists the studies that satisfied GAO's review criteria (as on p. 29), but only tabulates the reasons why other studies fail to meet this criteria (p. 27). We suggest that GAO specify the reasons why each of the unsatisfactory studies did not meet the criteria.

Now p. 85

The criteria utilized to select documents for consideration is logical and objective in that the reviewers subdivided the large group of documents into meaningful subsets for analysis and inference. This was accomplished through stratification of studies by outcome measures and methodology used (cross-sectional or before/after). In this way, a generalization of results could be permitted across studies within and between groups. In addition, the studies were rated based on a quantitative assessment of their quality in order to meet threshold requirements. The results of the studies were amazingly consistent which increases one's confidence in the generalization of the findings.

Other Comments:

Now p. 22.

On p. 21, GAO utilizes the terms "Driver Fatal Crashes," "Driver Fatal/Injury Crashes," etc., when referring to drivers involved in fatal crashes. GAO's terminology implies driver fatalities rather than involvement. We recommend that these headings be changed to "Driver Involvement."

Now table 3.2, p. 28.

On p. 29, Table 4.2, at the intersection of "Design Attributes" and "Arnold" the entries should read: "1-6 years pre/1-5 years post using ratio analysis." In the same Table, at the intersection of "Controls" and "Williams, et al," the entry "license rate" is incorrect. This study did use "day-crashes" as a control.

Now p. 32.

On p. 40, Results of Synthesis, it is not clear that the level of statistical significance (.05) referred to is GAO's determination of what should be statistically significant or whether it is the original researchers' specification for the test of hypothesis.

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